# FRIANT DIVISION
# LONG-TERM CONTRACT RENEWAL
# ENVIRONMENTAL ASSESSMENT

**DRAFT**

**Bureau of Reclamation**
**Mid-Pacific Region**
**South Central California Area Office**
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**Fresno, California 93727-1551**

**October 16, 2000**

# EXECUTIVE SUMMARY

## INTRODUCTION

The U.S. Bureau of Reclamation (Reclamation) is preparing an environmental assessment (EA) to renew existing water service contracts for a period of 25 years after the appropriate environmental review.

The purpose of this project is to renew long-term water service contracts to the Friant Division, consistent with the provisions of Central Valley Project Improvement Act (CVPIA). The project alternatives will include the terms and conditions of the contracts, and tiered water pricing.

Long-term contract renewal is necessary to:

- Continue beneficial use of water, developed and managed as part of the Central Valley Project (CVP), with a reasonable balance among competing demands, including the needs of irrigation and domestic uses; fish and wildlife protection, restoration, and mitigation; fish and wildlife enhancement; power generation; recreation; and other water uses consistent with requirements imposed by the State Water Resources Control Board and the CVPIA.

- Incorporate certain administrative conditions into the renewed contract to ensure CVP continued compliance with current federal reclamation law and other applicable statutes.

- Allow the continued reimbursement to the federal government for costs related to CVP construction and operation.

Long-term contract renewals (LTCRs) require environmental documentation prepared at the division or unit level. The EA analyzes the localized impacts of continued water delivery to 28 contractors in the Fraint Division resulting from a LTCR for a period of 25 years (Table ES-1).

**Table ES-1**
**CVP Friant Division Class 1 and 2 Contractual Entitlements**

| Friant Division | Class 1 (acre feet/year) | Class 2 (acre feet/year) |
|---|---|---|
| Arvin-Edison Water Storage District | 40,000 | 311,675 |
| Chowchilla Water District | 55,000 | 160,000 |
| County of Madera | 200 | 0 |
| Delano-Earlimart Irrigation District | 108,800 | 74,500 |
| Exeter Irrigation District | 11,500 | 19,000 |
| City of Fresno | 60,000 | 0 |
| Fresno County Waterworks #18 | 150 | 0 |
| Fresno Irrigation District | 0 | 75,000 |
| Garfield Water District | 3,500 | 0 |
| Gravelly Ford Water District | 14,000 | 0 |
| International Water District | 1,200 | 0 |

**Table ES-1**
**CVP Friant Division Class 1 and 2 Contractual Entitlements**

| Friant Division | Class 1 (acre feet/year) | Class 2 (acre feet/year) |
|---|---|---|
| Ivanhoe Irrigation District | 7,700 | 7,900 |
| Lewis Creek Water District | 1,450 | 0 |
| Lindmore Irrigation District | 33,000 | 22,000 |
| City of Lindsay | 2,500 | 0 |
| Lindsay-Strathmore Irrigation District | 27,500 | 0 |
| Lower Tule River Irrigation District | 61,200 | 238,000 |
| Madera Irrigation District | 85,00 | 186,000 |
| City of Orange Cove | 1,400 | 0 |
| Orange Cove Irrigation District | 39,200 | 0 |
| Porterville Irrigation District | 16,000 | 30,000 |
| Saucelito Irrigation District | 21,200 | 32,800 |
| Shafter-Wasco Irrigation District | 50,000 | 39,600 |
| Southern San Joaquin Municipal Utility District | 97,000 | 50,000 |
| Stone Corral Irrigation District | 10,000 | 0 |
| Tea Pot Dome Water District | 7,500 | 0 |
| Terra Bella Irrigation District | 29,000 | 0 |
| Tulare Irrigation District | 30,000 | 141,000 |

The Friant Division operating facilities, including Millerton Lake (Friant Dam), the Friant-Kern Canal, and the Madera Canal are located on the eastern side of the San Joaquin Valley. Water for the Friant Division comes from the San Joaquin River at Millerton Lake with a storage capacity of 520,000 ace feet (af). From there, water is released from the reservoir to the 152-mile long Friant-Kern Canal flowing south and 36-mile long Madera Canal flowing north. The flow rate of the Friant-Kern Canal and the Madera Canal is 5,300 and 1,000 cubic feet per sec (cfs), respectively. Water conveyed to the Friant Division is categorized as Class 1 and Class 2 water. Class 1 water is available on an annual basis while Class 2 water is available only during certain hydrologic conditions. The total Class 1 water under contract is about 800,000 af. Class 2 water is available as hydrologic conditions permit and totals about 1,387,475 af under contract.

Although not part of the Friant Division, the Buchanan and Hidden Units provide CVP project water to Friant Division contractors through H.V. Eastman Lake and Hensley Lake. Eastman and Hensley Lakes are operated by the Army Corp of Engineers. With a capacity of 150,600 af, a maximum of 45,000 af is allocated during flood seasons for flood control storage from Buchanan Dam. Water flows to the 30 mile-long Chowchilla Bypass Canal via Ash Slough, the main tributary of Chowchilla River providing CVP project water to the Chowchilla Water District.

Hensley Lake (formerly Hidden Lake) is located on the Fresno River about 15 miles northeast of the City of Madera. With a capacity of 82,500 af, a maximum of 65,000 af is allocated during flood seasons for flood control storage. The Fresno River flows from Hensley Lake to the 13.3 mile-long Madera Canal and provides CVP project water to the Madera Irrigation District.

## Description of Alternatives

The No Action Alternative (NAA) assumes renewal of long-term CVP water service contracts for a period of 25 years in accordance with minimum implementation of CVPIA as described in the PEIS Preferred Alternative. The PEIS Preferred Action assumed that most contract provisions would be similar to the provisions in the 1997 CVP Interim Renewal Contracts, which included contract terms and conditions consistent with the requirements for CVPIA. In addition, the NAA assumed tiered pricing provisions and environmental commitments as described in the PEIS Preferred Alternative.

These provisions were described in the Final PEIS. These issues include tiered water pricing, definition of municipal and industrial water users, water measurement, and water conservation.

## Alternative 1

Alternative 1 is based upon the proposal presented by CVP water service contractors to Reclamation in April 2000. However, there were several issues included in the April 2000 proposal that could not be included in Alternative 1 because they are not consistent with existing Federal or state requirements or would require a separate Federal action.

## Alternative 2

Alternative 2 is based upon the proposal presented by Reclamation to CVP water service contractors in November 1999. However, there were several provisions included in the November 1999 proposal that could not be included in Alternative 2 because they would require a separate Federal action.

The November 1999 proposal did include several provisions that were different than the assumptions for NAA and included in Alternative 2. The primary differences are related to tiered pricing and the definition of municipal and industrial users.

## Summary of Impacts

The potential impacts associated with the alternatives are summarized below and are described in detail in Section 3 of the EA (Table ES-2).

**Table ES-2**
**Summary of Potential Impacts**

| Resources | No Action Alternative | Alternative 1 | Alternative 2 |
|---|---|---|---|
| **Surface Water** | Based on the conjunctive use design of the Friant Division, Contractors are expected to continue mixed use of CVP surface water and ground water, with greater emphasis on ground-water use during dry periods when CVP surface water is limited. | Similar effect as the NAA. | Little or no change in surface water use is anticipated for most year types. The largest change is in subarea 13 (Madera ID and Gravely Ford ID) for wet years following a dry five-year period shifting from surface water to ground water. Approximately 113,100 af less surface water would be taken in this subregion for this specific combination of years. Water may remain in Millerton Lake until purchased by another contractor or could be spilled. This would potentially result in a change in the timing of some of the releases to the two canals. The operation of Buchanan Dam and Hidden Dam will not change with this alternative. |
| **Water Supply** | Historic operation of the Friant-Kern Canal, Madera Canal, Millerton Lake, Hensley Lake, and Eastman Lake will remain the same under the NAA relative to historic conditions. The conjunctive use of ground water and surface water is not expected to change under the provisions of the NAA. | Similar effect as the NAA. | Minimal changes are anticipated for irrigated acres in most year types for most of the subbasins. In most of the combinations of years simulated in CVPM, there was little or no change in surface and ground water use relative to the NAA. Flood control releases that have historically been made down the Friant-Kern and Madera Canals will continue. |

**Table ES-2**
**Summary of Potential Impacts**

| Resources | No Action Alternative | Alternative 1 | Alternative 2 |
|---|---|---|---|
| | | | Redistribution of surface water and ground water usage in certain years because of tiered water pricing is anticipated. These effects reflect a redistribution of water supplies for one-year periods and not a long-term shift in water supply. Overall, the water supply is still available to the contractors and will be used in the Division. There is no impact to surface water. |
| **Ground Water** | During dry conditions, ground water usage increases in response to decreases in surface water supplies. Contractors return to greater surface water usage after the dry condition end. | Similar effect as the NAA. | In most areas, a single year of substantially increased ground water pumping is unlikely to critically affect ground water elevations. The long-term effect of increases and decreases in ground water pumping is unknown at this time because water users may respond differently than predicted in the model. |

**Table ES-2**
**Summary of Potential Impacts**

| Resources | No Action Alternative | Alternative 1 | Alternative 2 |
|---|---|---|---|
| **Water Quality** | Water quality in the rivers and ground water of the Friant Division is not anticipated to change significantly from past conditions. Factors that tend to influence water quality, such as agricultural runoff, will be similar to historic conditions. Because ground water quality is influenced by factors such as deep percolation of applied water, a shift in the quality of applied water may change the ground water quality. | Similar effect as the NAA. | The long-term effect of increases and decreases in ground water pumping is unknown at this time because water users may respond differently than predicted in the model. It is unknown if other years with decreased ground water pumping would offset this increase over the long term. Depending on the geographic areas where the pumping would increase, the quality of the water used for irrigation may be less than the quality of the surface water available under the NAA. |
| **Fisheries** | Water use is expected to continue as it has using both CVP surface water supplies and ground water. Ground water has typically been more important during dry years when CVP water is less available. | Similar effect as the NAA. | Any redistribution of water not purchased depends on many factors. It could result in more water being released into the Friant-Kern or Madera canals, more water stored in Millerton Lake, or more water released into the San Joaquin River.<br><br>Water would remain in Millerton Lake until purchased by Firant users. Water not purchased would likely be picked up by other users. This could result in different timing in the movement of water in the canals. |

**Table ES-2**
**Summary of Potential Impacts**

| Resources | No Action Alternative | Alternative 1 | Alternative 2 |
|---|---|---|---|
| **Land Use** | Changes in irrigated acres are relatively small because a high percent of land in the subregions is planted in permanent crops and the availability of ground water as a replacement for decreased CVP supplies. | Similar effect as the NAA. | The greatest reduction in irrigated acreage is when a wet year follows a series of dry years. Even so, the 2,700 acre reduction represents a reduction of only 0.1 percent over the NAA wet year acreage of 1,058.2 acres. The analysis of M&I use of CVP water shows that there is no reduction in deliveries. |
| **Biological** | Existing Friant Division management will continue under current conditions. No impacts to vegetation and wildlife are expected, since no additional infrastructure (*e.g.*, dams, increase a dam heights, canals, etc.) will be constructed. Additionally, under this alternative, there will be no increase in deliveries and no conversion of existing natural habitat into farmland. | Similar effect as the NAA. | The additional water cost could result in an increase in the amount of lands left fallow. If fallowed lands are restored to native conditions, they could provide habitat for regional vegetation and wildlife.<br><br>A decrease in some agricultural crops (e.g., alfalfa and grain crops) however, could potentially impact the amount of nesting and feeding habitat for wildlife in the area. While a reduction in the amount of alfalfa or grain acreage could impact some species, restoration of these lands to a more natural condition would likely provide benefits to listed and other species considered sensitive. |

**Table ES-2**
**Summary of Potential Impacts**

| Resources | No Action Alternative | Alternative 1 | Alternative 2 |
|---|---|---|---|
| | | | As the cost of water increases, the opportunity to provide wetland habitat by private landowners generally decreases. This could result in a decrease in availability of wetland habitat in the Friant Division region. However, if water use decreases, more water may be available to flow down the San Joaquin, Chowchilla, and Fresno Rivers. Increased flows along these waterways would enhance the riparian zones, resulting in enhanced habitat quality for wildlife. |
| **Recreational** | The operation of CVP facilities does not change. Reservoirs and the recreational resources are not changed. | Similar effect as the NAA. | Similar to the NAA. |
| **Socioeconomic** | The NAA will have a less than significant effect on economic resources. The largest variations seen in irrigated acres, gross revenue, net revenue, and employment in the region change with the weather and commodity demands. The change in irrigated acres from an Average Year to a Dry Year decreases by two percent. The change in gross revenue between an Average Year to a Dry Year decreases by one percent. In Wet Years net income decreases by one percent. The change in employment between an Average Year to a Dry Year decreases by less than one percent. | Similar effect as the NAA. | Similar to the NAA, the alternative will have a minor effect. The change in irrigated acres from an Average Year to a Dry Year decreases by less than one percent. The change in gross revenue decreases by one percent in all scenarios. The change in regional employment decreases by less than one percent. |

**Table ES-2**
**Summary of Potential Impacts**

| Resources | No Action Alternative | Alternative 1 | Alternative 2 |
|---|---|---|---|
| **Cultural** | The NAA would not result in direct impact to eligible or significant cultural resources. Water apportioned under the NAA may be used to alter the use of a landscape, either through inundation, irrigation-related construction, or some other change which could impact cultural resources. The entities responsible at this level for potential impacts to cultural resources are the contracting agencies – the individual water districts. | Similar effect as the NAA. | Similar to the NAA. |
| **Social Conditions** | The operation of the CVP facilities do not change and the social conditions are not changed. | Similar effect as the NAA. | Similar to the NAA. |
| **Air Quality** | The existing operations of CVP facilities do not change and air quality does not change. | Similar effect as the NAA. | Similar to the NAA. |
| **Geology and Soils** | The operation of CVP facilities and reservoirs does not change and the soil and geology resources are not changed. | Similar effect as the NAA. | Over the long-term the ground water use in subbasin 17 would decrease. To reduce soil erosion, retired or fallowed lands are assumed to have cover crop planted in the last year of cultivation. |
| **Visual** | The CVP facilities and reservoirs do not change and the visual resources do not change. | Similar effect as the NAA. | Similar to the NAA. |

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AAQS | Ambient Air Quality Standard |
| af | acre-feet |
| af/yr | acre-feet per year |
| AFRP | Anadromous Fish Restoration Program |
| APE | area of potential effect |
| CALFED | CALFED Bay-Delta Program |
| CEQA | California Environmental Quality Act |
| CFR | Code of Federal Regulations |
| cfs | cubic feet per second |
| COE | Army Corp of Engineers |
| CRHR | California Register of Historic Resources |
| CVGSM | Central Valley Groundwater-Surface Water Simulation Model |
| CVP | Central Valley Project |
| CVPM | Central Valley Production Model |
| CVPIA | Central Valley Project Improvement Act |
| Delta | Sacramento-San Joaquin River Delta |
| EA | Environmental assessment |
| EIR | Environmental Impact Report |
| EPA | U.S. Environmental Protection Agency |
| ESA | Endangered Species Act |
| FWUA | Friant Water Users Authority |
| HABS/HAER | Historic American Building Survey/Historic American Engineering Register |
| LTCR | long-term contract renewal |
| mg/L | Miligrams per liter |
| NAA | No Action Alternative |
| NAHC | California Native American Heritage Commission |
| NEPA | National Environmental Policy Act |
| NHPA | Natural Historic Preservation Act |
| NRDC | National Resource Defense Council |
| M&I | Municipal and industrial |
| PEIS | Programmatic Environmental Impact Statement |
| $PM_{10,2.5}$ | Particulate matter less than or equal to 10 or 2.5 microns |
| Reclamation | U.S. Bureau of Reclamation |
| Regional Board | Central Valley Regional Water Quality Control Board |
| SANJASM | San Joaquin Area Simulation Model |
| SJRRHRP | San Joaquin River Riparian Habitat Restoration Program |
| Service | U.S. Fish and Wildlife Service |
| State Board | State Water Resources Control Board |
| SWP | State Water Project |
| USFS | U.S. Forest Service |
| VMS | Visual management system |
| Fg/L | Micrograms per liter |
| Fg/$m^3$ | Micrograms per cubic meter |

# GLOSSARY OF TERMS

| | |
|---|---|
| Category 1 Water | Quantity of project water is reasonably likely to be available during a year for delivery to the contractor, and will be calculated on an annual basis as the average quantity of delivered water provided to the contractor during the most recent 5-year period for which the contracting officer has completed or finalized total water deliveries for project rate-setting purposes. |
| Category 2 Water | Additional quantity of project water in excess of Category 1 water that may be delivered to the contractor in some Years. |
| Class 1 Water | Portion of the Friant Division two-class system of water allocation. Class 1 water is the firm supply amounting to the first 800,000 acre-feet of yield from the San Joaquin River and Millerton Reservoir. |
| Class 2 Water | Portion of the Friant Division two-class system of water allocation. Class 2 water is the available supply after the Class 1 water allotment has been fully met. |
| Contract Rate | The water service rate required in the contractor's current contract. Equal to the operation and maintenance expenses plus capital cost recovery for CVP facilities without interest charges. |
| Cost-of-Service Rate | The annual rate established pursuant to the then applicable water rate-setting policies that will recover all costs assigned to the irrigation and Municipal and industrial water supply functions, respectively, within the established repayment period. |
| Fixed Rate | Flat rate established in the original long-term water service contract. The fixed rate for irrigation typically ranges between \$2.00 – 8.00 per acre-foot. Municipal and industrial fixed rates typically range from \$9.00 – 18.50 per acre-foot. |
| Full Cost Rate | Irrigation and Municipal and industrial cost-of-service rates that repay capital with interest using interest rates and methodology set under Reclamation Reform Act Section 202(3). |
| Repayment Period | The time frame for recovery of the capital investment of a project. The repayment period for CVP In-Basin facilities is fiscal year 1981 through fiscal year 2030. The repayment period for CVP Out-of-Basin facilities extends from fiscal year 1987 through fiscal year 2036. |
| Tiered Water Pricing | The payments per acre-foot of CVP water calculated pursuant to Article 7(b) of the renewal contract that are required to be remitted to the U.S. in support of tiered water pricing charges pursuant to the CVPIA. |

SECTION 1

# PURPOSE AND NEED

## INTRODUCTION

On October 30, 1992, the President signed into law the Reclamation Projects Authorization and Adjustment Act of 1992 (Public Law 102-575) that included Title XXXIV, the Central Valley Project Improvement Act. The CVPIA amended the previous authorizations of the CVP to include fish and wildlife protection, restoration, and mitigation as project purposes having equal priority with irrigation and domestic uses and fish and wildlife enhancement as a project purpose equal to power generation. Through CVPIA, Interior is developing policies and programs to improve environmental conditions that were affected by operations, management, and physical facilities of the CVP. The CVPIA also includes tools to facilitate larger efforts in California to improve environmental conditions in the Central Valley and the San Francisco Bay-Delta system. The PEIS addressed potential impacts and benefits implementing provisions of the CVPIA. The PEIS was prepared by Reclamation and the Service.

The analysis in the PEIS was intended to disclose the probable region-wide effects of implementing the CVPIA and provide a basis for selecting a decision among the alternatives. The PEIS was developed to allow subsequent environmental documents to incorporate PEIS analysis by reference and limit the need to re-evaluate the region-wide and cumulative impacts of CVPIA. In some cases, worst-case assumptions were used to maximize the utility of the analysis for tiering within the scope of the impacts analyzed in the PEIS.

As the project-specific actions are considered, the lead agencies must determine if the specific impacts were adequately analyzed in the PEIS. If the actions under consideration were previously evaluated and the impacts of such actions would not be greater than those analyzed in the PEIS or would not require additional mitigation measures, the actions could be considered part of the overall program approved in the PEIS Record of Decision (ROD). In such a case, an administrative decision could be made that no further environmental documentation would be necessary. If a tiered document is appropriate, the tiered document may be an EIS or an EA. The tiered documents can use the PEIS by reference to avoid duplication and focus more narrowly on the new alternatives or more detailed site-specific effects. Therefore, only changes from the alternatives considered in the PEIS would be addressed in detail in the tiered documents.

### Localized Impacts of PEIS on Preferred Alternative

The primary impact to CVP water service contractors, as described in the PEIS, is not due to contract provisions, but rather to the implementation of CVPIA. The re-allocation of CVP water to fish and wildlife purposes under CVPIA reduced average annual CVP water deliveries to water service contractors from 2,270,000 acre-feet/year under the PEIS No-Action Alternative to 1,933,000 acre-feet/year under all of the PEIS alternatives, including the Preferred Alternative. The reduction occurred differently for various classifications of users, as summarized below.

- Average Annual CVP Water Deliveries for Cross Valley Agricultural water service contractors and Agricultural water service contractors located in the Friant Division decreased 18 percent from pre-CVPIA Affected Environment conditions.

- Average Annual CVP Water Deliveries for Cross Valley Municipal water service contractors and Municipal water service contractors located in the Friant Division decreased 6 percent from pre-CVPIA Affected Environment conditions.

## PURPOSE AND NEED

The purpose of this project is to renew the Friant division water service contracts, consistent with the provisions of CVPIA. The project alternatives will include the terms and conditions of the contracts.

Long-term contract renewal (LTCR) is necessary to:

- Continue beneficial use of water, developed and managed as part of the CVP, with a reasonable balance among competing demands, including the needs of irrigation and domestic uses; fish and wildlife protection, restoration, and mitigation; fish and wildlife enhancement; power generation; and other water uses consistent with requirements imposed by the State Water Resources Control Board (State Board) and the CVPIA.

- Incorporate certain administrative conditions into the renewed contract to ensure CVP continued compliance with current federal reclamation law and other applicable statutes.

- Allow the continued reimbursement to the federal government for costs related to CVP construction and operation.

The LTCRs require environmental documentation prepared at the division or unit level. Referred to as tiering, the Friant Division Environmental Assessment (EA) is developed from the PEIS using the PEIS as a foundation and concentrates on the issues specific to the Friant Division. This concentration helps eliminate repetitive studies and discussions and allows the unit-specific documents to focus on specific issues. The EA analyzes the localized impacts of continued water delivery to 28 contractors in the Friant Division resulting from a LTCR for a period of 25 years (Table PN-1). General discussions presented in the PEIS are incorporated by reference. Prior to renewal of the long-term service contracts, the EA must be completed, Findings of No Significant Impact signed, and a PEIS ROD published.

**Table PN-1**
**CVP Friant Division Class 1 and 2 Contractual Entitlements**

| Friant Division | Class 1 (acre-feet/year) | Class 2 (acre-feet/year) |
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| Orange Cove Irrigation District | 39,200 | 0 |
| Porterville Irrigation District | 16,000 | 30,000 |
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| Shafter-Wasco Irrigation District | 50,000 | 39,600 |
| Southern San Joaquin Municipal Utility District | 97,000 | 50,000 |
| Stone Corral Irrigation District | 10,000 | 0 |
| Tea Pot Dome Water District | 7,500 | 0 |
| Terra Bella Irrigation District | 29,000 | 0 |
| Tulare Irrigation District | 30,000 | 141,000 |

Source: Reclamation 1999c

## STUDY AREA

The study area includes the Friant Division water user service area and the Friant Division operating facilities. These facilities include Millerton Lake (Friant Dam), the Friant-Kern Canal, and the Madera Canal. The Friant Division is located on the eastern side of the San Joaquin Valley and contains the Friant Unit (Figure PN-1). Water for the Friant Division comes from the San Joaquin River at Millerton Lake with a storage capacity of 520,000 ace feet (af). From there, water is released from the reservoir to the 152-mile long Friant-Kern Canal flowing south and 36-mile long Madera Canal flowing north. The flow rate of the Friant-Kern Canal and the Madera Canal is 5,300 and 1,000 cubic feet per sec (cfs), respectively. Water conveyed to the Friant Division is categorized as Class 1 and Class 2 water. Class 1 water is available on an annual basis while Class 2 water is available only during certain hydrologic conditions. The total Class 1 water under contract is about 800,000 af. Class 2 water is availability as hydrologic conditions permit and totals about 1,401,475 af under contract.

Although not part of the Friant Division, the Buchanan and Hidden Units provide CVP project water to Friant Division contractors through H.V. Eastman Lake and Hensley Lake. Eastman and Hensley Lakes are operated by the Army Corp of Engineers (COE). H.V. Eastman Lake is located on the Chowchilla River about 15 miles northeast of the City of Chowchilla. Structures associated with the lake area comprised of the rock filled Buchanan Dam, five dikes, an ungated spillway section, outlet works, and extensive channel system. With a capacity of 150,600 af, a maximum of 45,000 af is allocated during flood seasons for flood control storage. From Buchanan Dam, water flows to the 30 mile-long Chowchilla Bypass Canal via Ash Slough, the main tributary of Chowchilla River.

Hensley Lake (formerly Hidden Lake) is located on the Fresno River about 15 miles northeast of the City of Madera. Structures associated with the lake are comprised of the rolled earthfill Hidden Dam, six dikes, an ungated spillway section, outlet works, and extensive channel system. With a capacity of 82,500 af, a maximum of 65,000 af is allocated during flood seasons for flood control storage. The Fresno River flows from Hensley Lake to the 13.3 mile-long Madera Canal.

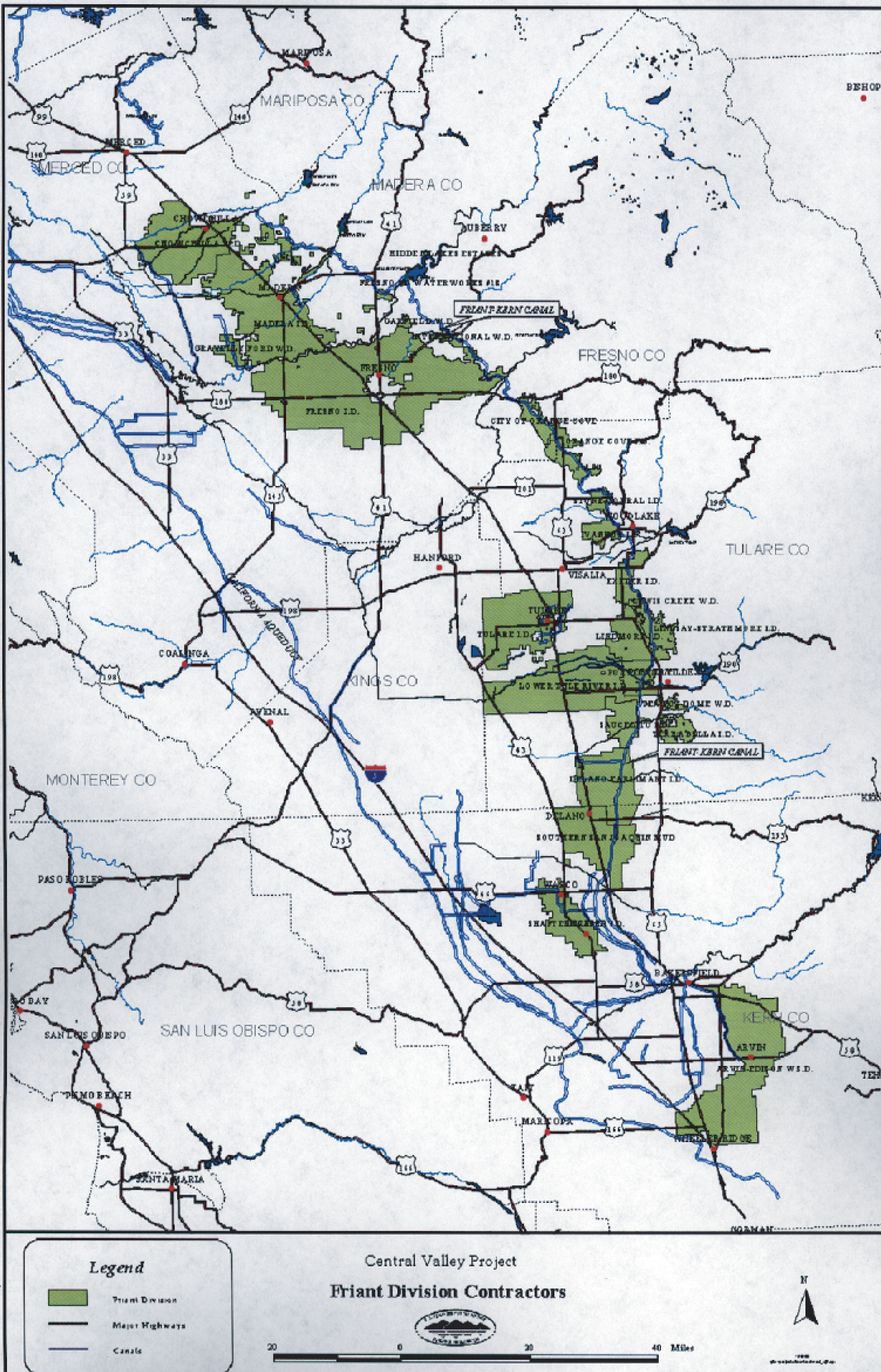
The Buchanan Unit provides Chowchilla Water District with 24,000 af of CVP project water. The Hidden Unit provides Madera Irrigation District with 24,000 af CVP project water.

## STUDY PERIOD

The analysis for this EA was conducted for projected conditions in the Year 2026 which will extend through the first period of renewal for the 25-year long-term water service contracts. Interim time period conditions were not considered or evaluated with respect to changes in the CVP contract.

## PUBLIC INVOLVEMENT PROCESS

The LTCR process was conducted as a public process. Throughout the contract renewal process, meetings were held with the contractors, other agencies, interest groups, and the public. Issues raised during the public involvement process were addressed in the negotiations process and were used in the preparation of this EA.



MARIPOSA
MARIPOSA CO
MERCED
MERCED CO
MADERA CO
CHOWCHILLA
MADERA
MADERA I.D.
FRESNO
FRESNO I.D.
FRESNO CO
FRIANT-KERN CANAL
TULARE CO
HANFORD
VISALIA
TULARE
TULARE I.D.
LOWER TULE RIVER I.D.
KINGS CO
COALINGA
AVENAL
CALIFORNIA AQUEDUCT
MONTEREY CO
PASO ROBLES
DELANO
SOUTHERN SAN JOAQUIN MUD
WASCO
SHAFTER-WASCO I.D.
BAKERSFIELD
KERN CO
ARVIN
ARVIN-EDISON W.S.D.
TAFT
MARICOPA
SAN LUIS OBISPO CO
SAN LUIS OBISPO
PISMO BEACH
SANTA MARIA
BISHOP
Legend
Friant Division
Major Highways
Canals
Central Valley Project
Friant Division Contractors
20
0
20
40
Miles
N

Reclamation started the preparation of this EA during the scoping phase. Scoping served as a fact-finding process that helped identify public concerns and recommendations about the National Environmental Policy Act (NEPA) process, issues that would be addressed in this EA, and the scope and level of detail for analyses. Scoping activities began on October 15, 1998, after a Notice of Intent to prepare the environmental documents on LTCR of CVP repayment and water service contracts. Reclamation held eight scoping meetings throughout the CVP service area (Oakland, Los Molinos, Fresno, Williams, Sacramento, Visalia, Gilroy, Modesto) during the first three weeks of November 1998. On January 8, 1999, scoping for these documents was closed. In April 1999, the findings of the scoping meetings were published in the CVP LTCR Scoping Report. On October 6, 1999, a meeting with a representative of Friant Water Users Authority (FWUA) was held in Sacramento, California to discuss the possible issues of concern to the water users.

## RELATED ACTIVITIES

There are related activities that are currently being implemented or planned by Reclamation and other agencies related to the use and availability of CVP water. Additionally, Reclamation is implementing many activities related to the CVPIA similar to those presented in the PEIS. Related studies and projects are summarized in Table PN-2. Preliminary information from these studies has been used to assess the cumulative impact analysis for each of the disciplines presented in the EA.

**Table PN-2**
**Related Activities**

| Project or Study and Lead Agency | Summary |
|---|---|
| CALFED Framework and ROD (CALFED) | Established in May 1995, the consortium of federal and state agencies is charged with the development of a long-term solution to the Delta water concerns. This process could change the Bay-Delta operations criteria, provide additional conveyance and storage facilities that would effect Delta exports, and identify actions that may need to be met by the CVP and other water rights holders. Because the outcome of this study was not known, a conservative assumption was used in the Draft PEIS. It was assumed in the Draft PEIS that the Bay-Delta Plan Accord criteria would be the long-term plan for the Delta. CALFED is completing an EIR/EIS as part of this process. |
| Sacramento River Toxic Pollutant Control Program - State Board and Central Valley Regional Water Quality Control Board (Regional Board) | Program to reduce pollutants into the Sacramento River, especially metals. This program could improve fishery conditions in the Sacramento River. The Draft PEIS assumes that this program is ongoing in the Year 2026. |
| San Joaquin River Comprehensive Plan (CVPIA Section 3406.c.1) | Congress directed Reclamation to develop a comprehensive plan to address fish, wildlife, and habitat concerns on the San Joaquin River. The objective was to identify improvements needed to reestablish and sustain anadromous fisheries from Friant Dam to the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (CVPIA §3406.c.1). Although the San Joaquin River comprehensive plan was initiated in 1992, strong public opposition to the study was received during a public outreach program in 1995. A majority of the fears stemmed from the possible impacts to the existing agricultural and economic structure in areas adjacent to the San Joaquin River. Based on stakeholder opposition, Congress eliminated project funding and the study was terminated in 1996. |
| San Joaquin River Riparian Habitat Restoration Program (SJRRHRP) | The SJRRHRP was formed in 1997, at the request of the FWUA and the NRDC, to pursue riparian habitat restoration studies and efforts along the San Joaquin River corridor from Friant Dam to the confluence with the Merced River. SJRRHRP is a CVPIA project and therefore is co-managed by Reclamation and the Service. The FWUA, Friant, NRDC, the Pacific Coast Federation of Fishermen's Associations, San Joaquin River Exchange Contractors Water Authority, Service, and Reclamation are active on the |

**Table PN-2**
**Related Activities**

| Project or Study and Lead Agency | Summary |
|---|---|
| | management team. In its 3 years, the program has completed numerous biological and physical baseline reports and is presently pursuing several other projects and studies along the program reach. The SJRRHRP will continue to pursue studies and projects that are consistent with the mutual goals of Friant and the NRDC coalition. Water for this program does not presently come from the CVPIA's specific 800,000 af for environmental purposes. The water for this activity came from willing sellers. |
| San Joaquin River Riparian Flow Pilot Program | As an outgrowth to the SJRRHRP and a pending lawsuit (NRDC vs. Patterson), a pilot study was conducted by stakeholders including Reclamation, FWUA, NRDC, Pacific Coast Federation of Fishermen's Associations, and other environmental, conservation, and irrigation interests. Approximately 35,000 af of CVP water was released from Millerton Lake to the lower San Joaquin River as an experiment to enhance riparian flows. The objective of this one-time pilot study was to evaluate impacts of high flows on flood carrying capacities, changes in the river's geomorphology, interaction of augmented river flows to local groundwater conditions, river channel losses, and to promote riparian habitat. Evaluations were conducted on the ability to use high flows to promote dispersion and enhance germination of native riparian willow and cottonwood trees and encourage survival of young seedlings along a 52-mile stretch between Friant Dam and Mendota Pool in Fresno and Madera counties. Seedlings from the upper reaches of the San Joaquin River would be disbursed to lower portions of the river with less riparian growth. This one-time release would enhance growth along the San Joaquin River which typically receives little to no water.<br><br>Under the terms of the pilot project agreement, FWUA users supplied 35,000 af of CVP water. However, an exchange arrangement would replace the water donated by the FWUA users. Reclamation would replace the 35,000 af by redirecting water from the Delta that otherwise would have been scheduled for use at Mendota Pool. The redirected water would be conveyed down the California Aqueduct to the Cross Valley Canal in Kern County to complete the return of water to the Friant users. |

**Table PN-2**
**Related Activities**

| Project or Study and Lead Agency | Summary |
|---|---|
| | Additionally, Reclamation purchased and supplied 15,000 af of CVP water to make up for potentially significant river channel conveyance losses incurred between Friant Dam and Mendota Pool. This replacement water was also conveyed through the California Aqueduct to the Cross Valley Canal for delivery to the Friant users. The 1999 Pilot Program began on July 3, 1999 and concluded on February 29, 2000. Water for this activity came from willing sellers. No new water was allocated from the CVP.<br><br>The 2000 Pilot Project is being conducted by the SJRRHRP and involves a program of water releases on a 62.5-mile stretch of the main stream of the San Joaquin River. The project will generate data to guide the development of a long-term riparian habitat restoration plan for the San Joaquin River. The pilot study will provide information to: (1) help determine what is preventing successful seedling establishment on the San Joaquin River between Gravelly Ford and Mendota Pool and (2) refine the hydrologic and hydraulic modeling for the river including the validation of existing models and information on the ground water and surface water conditions in the project area. Key issues are potential effects on water surface elevations and flooding, levee stability, energy production, and biological resource enhancement. |
| Water Acquisition | CVPIA Section 3406(b)(3) states, "The Secretary...is authorized and directed to develop and implement a program in coordination and in conformance with the plan required under section 3406(b)(1) for the acquisition of a water supply to supplement the quantity of water dedicated to fish and wildlife purposes under section 3406(b)(2) and to fulfill the Secretary's obligations under paragraph 3406(d)(2) of this title. The program should identify how the Secretary intends to utilize, in particular the following options: improvements in or modifications of the operations of the project; water banking; conservation; transfers; conjunctive use; and temporary and permanent land fallowing, including purchase, lease, and option of water, water rights, and associated agricultural land." |

**Table PN-2**
**Related Activities**

| Project or Study and Lead Agency | Summary |
|---|---|
| | The water acquisition program has sought sources of water to augment the current CVP supply by an amount dedicated to fish and wildlife under the CVPIA. Any of the means to augment water supply identified in CVPIA would continue after the renewal of long-term contracts and, therefore, represent an additional water use in the Friant Division. |
| Friant Inflow Analysis | Reclamation is currently investigating the potential water supply benefits of working with the owners of reservoirs upstream of Millerton Lake to manage the upper basin water supply. The analysis is at the appraisal level stage and currently has no direct effect on this EA.<br><br>The project could identify alternatives to manage the basin water supply that would increase the supply in certain water year types or provide a water supply to a new use. If alternatives are developed in subsequent phases of the project that would alter reservoir operations in the basin, environmental documentation will be prepared to address the changes. |

SECTION 2
# DESCRIPTION OF ALTERNATIVES

## INTRODUCTION

This section summarizes the long-term water service contract negotiations process and descriptions of the alternatives considered in this EA.

### Long-Term Water Service Contract Negotiations Process

The CVPIA states that the Secretary shall, upon request, renew any existing long-term irrigation repayment or water service contract for the delivery of CVP water for a period of 25 years and may renew such contracts for successive periods of up to 25 years each. Consistent with the 1963 Act, M&I contracts shall be renewed for successive periods up to 40 years each under terms and conditions that are mutually agreeable. The CVPIA also states that no renewals shall be authorized until appropriate environmental review, including the PEIS, has been completed. The PEIS provided a programmatic environmental analysis and identified the need for site-specific environmental documents for the long-term contract renewal process.

The CVPIA also stated that contracts which expire prior to the completion of the PEIS may be renewed for interim periods. The interim renewal contracts reflect existing Reclamation law, including modifications due to the Reclamation Reform Act and applicable CVPIA requirements. The initial interim contract renewals were negotiated in 1994 with subsequent renewals for periods of 2 years or less to provide for continued water service. Many of the provisions from the interim contracts were assumed to be part of the contract renewal provisions in the description of the PEIS Preferred Alternative.

In 1998, the long-term contract renewal process was initiated. Reclamation reviewed the interim contract provisions that were consistent with Reclamation law and other requirements, comments from the Draft PEIS, and comments obtained during the interim contract renewal process. Reclamation proposed that the overall provisions of the long-term contract would be negotiated with representatives of all CVP water service contractors. Following the acceptance of the CVP-wide provisions, Reclamation proposed that division-specific provisions and, finally, contractor-specific provisions would be negotiated. Reclamation also proposed that all water service contracts except for Central San Joaquin Irrigation District, Stockton East Water District, and Colusa Drain Mutual Water Company would be renewed pursuant to this action. Contract renewals for these three districts would be delayed until the completion of water management studies for their primary sources of CVP water, the Stanislaus River and the Sacramento River.

Reclamation published the initial proposed contract in November 1999. There were several negotiations sessions throughout the next six months. The CVP water service contractors published a counter-proposal in April 2000. The November 1999 proposal represents one "bookend" for negotiations and the April 2000 proposal represents the other "bookend." The results of the negotiations are reflected in the subsequent proposals. The primary differences between the proposals are summarized in Table DA-1.

## Issues Considered as Part of Long-Term Contract Renewals

The long-term contract renewal process addressed several other issues in addition to the contract provisions. These issues include the needs analyses, changes in service areas, and water transfers.

### *Needs Analyses*

The water rights granted to the CVP by the SWRCB require the Federal government to determine that the water is being used in a beneficial manner. The needs analysis methodology was developed to indicate that the CVP water is being used beneficially. The needs analysis was computed for each District within the various divisions or units of the CVP using a multiple-step approach. First, the existing water demand was calculated for each district. For agricultural contractors, crop acreage, cropping patterns, crop water needs, effective precipitation, and conveyance losses were reviewed. For municipal and industrial contractors, residential, commercial, industrial, institutional, recreational, and environmental uses; landscape coefficients; system losses; and landscape acreage were reviewed. Second, future changes in water demands based upon crops, municipal and industrial expansion, and changes in efficiencies were reviewed. Third, existing and future non-CVP water supplies were identified for each district, including groundwater and other surface water supplies. The initial calculation of CVP water needs was limited by the assumption that groundwater pumping would not exceed the safe yield of the aquifer. In addition, the actual water needs were calculated at each division or unit level to allow for intra-regional transfers on an annual basis.

Beneficial and efficient future water demands were identified for each district. The demands were compared to available non-CVP water supplies to determine the need for CVP water. If the need was less than contract amounts, the CVP water service contract amount could be reduced. Because the CVP was initially established as a supplemental water supply for areas without adequate supplies, the needs for most districts are at least equal to the CVP water service contract and frequently exceeded the previous contract amount. However, this environmental analysis does not include increased total contract amounts. Therefore, the CVP contract amount will be limited by the existing CVP contract quantity.

### *Changes in Water Service Areas*

This environmental analysis does not consider changes in future water service area boundaries for use of CVP water. Any future changes to water service area boundaries for use of CVP water will be evaluated in separate technical and environmental analyses.

### *Water Transfers*

Several different types of transfers are considered for long-term contract renewals. Intra-CVP contract transfers have occurred regularly throughout the CVP and are frequently limited to scheduling changes between adjoining districts. Reclamation has historically issued and will continue to address these types of transfers under separate environmental analysis.

It is recognized that water transfers will continue to occur and that the CVP long-term contracts will provide the mechanism. Because CVPIA has allowed these transfers, as evaluated in the PEIS for the Preferred Alternative, the No Action Alternative (NAA) includes water transfer provisions. These provisions for transfers are also included in both Alternatives 1 and 2. However, it is difficult to identify all of the water transfer programs that could occur with CVP water in the next 25 years. Reclamation would continue with separate environmental documents for proposed transfers in establishing criteria and protocols to allow rapid technical and environmental review of future proposed transfers.

## DEVELOPMENT OF ALTERNATIVES

Three alternatives were identified for the renewal of long-term contracts between Reclamation and the contractors in the Friant Division, Buchanan Unit, and Hidden Unit.

The alternatives present a range of water service agreement provisions that could be implemented for long-term contract renewals. The No Action Alternative (NAA) consists of renewing existing water service contracts as described by the Preferred Alternative of the PEIS. In November 1999, Reclamation published a proposed long-term water service contract. In April 2000, the CVP Contractors presented an alternative long-term water service contract. Reclamation and the CVP Contractors continued to negotiate the CVP-wide terms and conditions with these proposals serving as “bookends.” This EA also considers these proposals with the NAA as bookends in the environmental documentation to evaluate the impacts and benefits of the renewing long-term water service contracts.

### No Action Alternative

The NAA assumes renewal of long-term CVP water service contracts for a period of 25 years in accordance with implementation of CVPIA as described in the PEIS Preferred Alternative. The PEIS Preferred Action assumed that most contract provisions would be similar to many of the provisions in the 1997 CVP Interim Renewal Contracts, which included contract terms and conditions consistent with applicable CVPIA requirements. In addition, the NAA assumes tiered pricing provisions and environmental commitments as described in the PEIS Preferred Alternative. The provisions of the NAA are summarized in Table DA-1.These provisions were described in the Final PEIS.

Several applicable CVPIA provisions are summarized in the description of the NAA as they are addressed in a different manner in Alternatives 1 and/or 2, and therefore could result in changes in environmental impacts or benefits. These issues include tiered water pricing, definition of municipal and industrial water users, water measurement, and water conservation.

***Class 1/Class 2 Water Supply.*** Within the Friant Division, water entitlements are classified as Class 1 and Class 2 water. The Class 1 water is defined as the quantity of water that could be delivered in a typical water year and is applied to both the irrigation and municipal and industrial (M&I) contracts. All water commitments identified for M&I use are identified as Class 1 water. The Class 1 total water delivery is announced each year for the entire division with each contractor receiving a prorated contractual amount. Class 2 water is delivered each year based on the available supply and is provided only for irrigation uses. Class 2 water is typically only available in the full contract amount during wet water years.

***Tiered Water Pricing.*** Tiered water pricing in the No Action Alterative is based upon use of a "80/10/10 Tiered Water Pricing from Contract Rate to Full Cost" including appropriate Ability-to-Pay limitations. Under this approach, the first 80% of the maximum contract total would be priced at the applicable Contract Rate. The next 10% of the contract total would be priced at a rate equal to the average of the Contract Rate and Full Cost Rate. The final 10% of the contract total would be priced at Full Cost Rate. The terms "Contract Rate" and "Full Cost Rate" are defined by the CVP rate setting policies, and P.L. 99-546 and the Reclamation Reform Act (RRA), respectively. The Contract Rate for irrigation and M&I water includes the contractor’s allocated share of CVP main project O&M, O&M deficit, and capital cost. The contract rate for irrigation water does not include interest on capital. The contract rate for M&I water includes interest on capital computed at the CVP M&I interest rate. The Full Cost rate for irrigation and M&I water includes interest at the RRA interest rate.

In addition to the CVP water rate, contractors are required to pay a Restoration payment on all deliveries on CVP water. Reclamation law and policy provides full or partial relief to irrigation contractors on Restoration Payments and the capital rate component of the water rate. Ability-to-pay relief, relative to the irrigation water rate, is fully applicable only to the first 80% of the contract total. Ability-to-pay relief is not applicable to the third tier water rate. The second tier may reflect partial Ability-to-pay relief, as it is equal to the average of the first and third tiers. The relief could be up to 100% of the capital cost repayment and is based upon local farm budgets. The Ability-to-Pay law and policy do not apply to CVP operation and maintenance costs, municipal or industrial water rates, CVP distribution facilities, or non-CVP water costs.

***Definition of Municipal and Industrial Users.*** The definition of municipal and industrial users was established in portions of a 1982 Reclamation policy memorandum. In many instances, the definition of municipal users is easily definable. However, with respect to small tracts of land, the 1982 memorandum identified agricultural water as agricultural water service to tracts that can support $5,000 gross income for a commercial farm operation. The memorandum indicates that this criteria can be generally met by parcels greater than 2 acres. Based on this analysis, the CVP has generally applied a definition of 5 acres or less for municipal and industrial uses in the CVP for many years. The CVP contractors can seek a modification for a demonstrated need of agricultural use on parcels between 2 and 5 acres in size and request such a modification from the Contracting Officer.

***Water Measurement.*** The NAA includes water measurement at every turnout or connection to measure CVP water deliveries. It is assumed that if other sources are co-mingled with the CVP water, including groundwater or other surface waters, that the measurement devices would report gross water deliveries. Additional calculations would be required to determine the exact quantity of CVP water. However, if groundwater or other surface waters are delivered by other means to the users, the NAA did not include additional measurement devices except as required by individual users' water conservation plans.

***Water Conservation.*** The water conservation assumptions in the NAA include water conservation actions for municipal and on-farm uses assumed in the DWR Bulletin 160-93; and conservation plans completed under the 1982 Reclamation Reform Act consistent with criteria and requirements of the CVPIA. Such criteria address cost-effective Best Management Practices that are economical and appropriate, including measurement devices, pricing structures, demand management, public information; and financial incentives.

## Alternative 1

Alternative 1 is based upon the proposal presented by CVP water service contractors to Reclamation in April 2000. However, there were several issues included in the April 2000 proposal that could not be included in Alternative 1 because they are not consistent with existing Federal or state requirements or would require a separate Federal action, as described below.

- The April 2000 proposal includes Terms and Conditions to provide a highly reliable water supply, and provisions to improve the water supply capabilities of the CVP facilities and operations to meet this goal - *These issues were not included in Alternative 1 because they would require additional Federal actions with separate environmental documentation and also limit the Secretary's obligation to achieve a reasonable balance among competing demands as required by the CVPIA. Currently Reclamation is completing the least cost plan to restore project yield in accordance with Section 3408(j) of CVPIA and under the CALFED program.*

- The April 2000 proposal includes language to require renewal of contracts after 25 years upon request of the contractor - *The study period for this EA is 25 years which coincides with the contract period applicable to irrigation contracts and required by CVPIA. Renewal after 25 years would be a new Federal Action and would require new environmental documentation.*

- The April 2000 proposal did not include provisions for compliance with biological opinions - *Biological consultations are required by the Consultation and Coordination requirements established by Executive Order for all Reclamation activities. These are binding on Reclamation and provisions are needed to address this requirement.*

- The April 2000 proposal included provisions for water transfers - *It is recognized that water transfers will continue and that the CVP long-term contracts will provide the mechanisms for the transfers. However, it would be difficult to identify all of the water transfer programs that could occur with CVP water in the next 25 years. Reclamation would continue with separate environmental documents for transfers, and will establish criteria for rapid technical and environmental review of proposed transfers.*

- The April 2000 proposal includes provisions for transfer of operations and maintenance requirements - *It is recognized that transfers of operation and maintenance to the group of contractors will continue and that the CVP long-term contracts will provide the mechanisms for such transfers. However, it would be difficult to identify all of the operation and maintenance transfer programs that could occur with CVP water in the* *next 25 years. Reclamation would require separate environmental documents for such transfers.*

- The April 2000 proposal includes provisions for resolution of disputes - *Assumptions for resolution of disputes were not included in Alternative 1 and at this time would not appear to affect environmental conditions.*

- The April 2000 proposal includes provisions for expansion of the CVP service areas by the existing CVP water contractors - *The study area for the long-term contract renewal process is defined by the existing service area boundaries. Expansion of the service area boundaries would be a new Federal Action and would require separate environmental documentation.*

The April 2000 proposal did include several provisions that were different than the assumptions for NAA and those provisions are included in Alternative 1, as summarized in Table 2-1. The April 2000 proposal also included several provisions that involve specific language changes that would not significantly modify CVP operations in a manner that would affect the environment as compared to the No-Action Alternative but could affect specific operations of a contractor, as described in Table 2-1.

It should be noted that the tiered pricing requirements (including unit prices for CVP water) and definition of municipal/industrial users in Alternative 1 would be the same as in the NAA.

## Alternative 2

Alternative 2 is based upon the proposal presented by Reclamation to CVP water service contractors in November 1999. However, there were several provisions included in the November 1999 proposal that are not be included in Alternative 2. These provisions would constitute a separate Federal action, as described below.

- The November 1999 proposal includes provisions for the contractor to request approval from Reclamation of proposed water transfers - *Water transfers were not included in Alternative 2 because such actions cannot now be definitely described and essentially constitute a separate Federal action and require separate environmental documentation.*

- The November 1999 proposal includes provisions for transfer of operations and maintenance third parties - *Operations and maintenance transfers were not included in Alternative 2 because these actions would be a separate Federal action and require separate environmental documentation.*

The November 1999 proposal did include several provisions that were different than the assumptions for NAA and included in Alternative 2, as summarized below and in Table DA-1. The primary differences are related to tiered pricing and the definition of municipal and industrial users.

***Class 1/Class 2 Water Supply.*** Within the Friant Division, water entitlements are classified as Class 1 and Class 2 water. The Class 1 water is defined as the quantity of water that could be delivered in a typical water year and is applied to both the irrigation and municipal and industrial (M&I) contracts. All water commitments identified for M&I use are identified as Class 1 water. The Class 1 total water delivery is announced each year for the entire division with each contractor receiving a prorated contractual amount. Class 2 water is delivered each year based on the available supply and is provided only for irrigation uses. Class 2 water is typically only available in the full contract amount during wet water years.

***Tiered Water Pricing.*** Tiered water pricing in Alternative 2 is based upon a definition of a "Category 1" and "Category 2" water supplies. "Category 1" is defined as the quantity of CVP water that is reasonably likely to be available for delivery to a contractor and is calculated on an annual basis as the average quantity of delivered water during the most recent 5 year period. For the purposes of this Alternative, the “Category 1" water supply is defined as the “contract total”. "Category 2" is defined as that additional quantity of CVP water in excess of Category 1 water that may be delivered to a contractor in some years. Under Alternative 2, the first 80% of Category 1 volume would be priced at the applicable Contract Rate for the CVP. The next 10% of the Category 1 volume would be priced at a rate equal to the average between the Contract Rate and Full Cost Rate as defined by Reclamation law and policy. The final 10% of the Category 1 volume would be priced at the Full Cost Rate as required by the CVPIA. All Category 2 water, when available, would be priced at Full Cost Rate (Figure DA-1). It should be noted that Category 1 and Category 2 volumes will change every year based upon the average deliveries for the "most recent 5 years," with limited exceptions, based upon the findings of the water needs assessment. Alternative 2 assumes the sum of Category 1 and Category 2 water is equal to the maximum quantity included in the contractors’ existing water service contract. The quantity is the same as the NAA and Alternative 1. The terms "Contract Rate" and "Full Cost Rate" are discussed under Tiered Pricing for the NAA. The same Ability-to-Pay adjustments would be applicable to Restoration Payments and tiered water rates as described in the NAA.

| Water Rate | Contractual Entitlement | Water Classification |
|---|---|---|
| | Full Contract Amount | |
| Tier 3<br>Full Cost Rate | Threshold | Category 2[a] |
| | 90% of Threshold | Category 1[b] |
| Tier 2<br>Aug. of Contract Rate<br>and Full Cost Rate | 80% of Threshold | |
| Tier 1<br>Contract Rate | | |

[a] Includes the remaining 62% of Class 2 contractual entitlement.
[b] Includes 100% of Class 1 and 38% of Class 2 contractual entitlement.

**Figure DA-1**
**Category and Tier Water Pricing Relationship**

The prices of CVP water used in Alternative 2 are based upon irrigation and municipal/industrial CVP water rates presented in the November 17, 1999 Financial Workshop Handouts 1 and 2.

All of the Friant Division Class 1 water and 38% of the Friant Division Class 2 contract amount is in the Category 1 pricing structure. The remaining 62% of the Friant Division Class 2 water is in the Category 2 pricing structure.

***Definition of Municipal and Industrial Users.*** The definition of municipal and industrial water includes all tracts less than or equal to 5 acres unless the Contracting Officer is satisfied that the use of such water meets the definition of "Irrigation Water".

## ALTERNATIVES CONSIDERED BUT ELIMINATED

### Nonrenewal of Long-Term Contracts

Nonrenewal of existing contracts is considered infeasible based on Section 3404(c) of the CVPIA. This alternative was considered but eliminated from analysis in this EA because Reclamation has no discretion not to renew the contracts.

### Reduction in Contract Amounts

Reduction of contract amounts was considered in certain cases but rejected from analysis. The reason for this was twofold. Water needs analyses have been completed for all contracts and in almost all cases the needs exceed or equal the current total contract amount. Secondly, in order to implement good water management, the contractors need to be able to store or immediately use water available in wetter years when more water is available. By quantifying contract amounts in terms of the needs analyses and the CVP delivery capability, the contractors can make their own economic decisions. Allowing the contractors to retain the full water quantity gives the contractors assurance that the water will be available to them for storage investments. In addition the CVPIA, in and of itself, achieves a balance in part through its dedication of significant amounts of CVP water and actions to acquire water for environmental purposes.

## SELECTION OF THE PREFERRED ALTERNATIVE

It is anticipated that the final contract language and the long-term contract renewal Preferred Alternative will represent a negotiated position between Alternatives 1 and 2. Therefore, it is anticipated that the impacts will be either equal to or less than those identified for Alternative 1, Alternative 2, or NAA. A summary of the alternative impacts is provided in Table DA-2.

**Table DA-1**
**Comparison of Contract Provisions Considered in Alternatives**

| | **No Action Alternative** | **Alternative 1** | **Alternative 2** |
|---|---|---|---|
| **Provision** | **Based on PEIS and Interim Contracts** | **Based on April 2000 Proposal** | **Based on November 1999 Proposal** |
| **Explanatory Recitals** | Assumes water rights held by CVP from SWRCB for use by water service contractors under CVP policies | Assumes CVP Water Right as being held in trust for project beneficiaries that may become the owners of the perpetual right. | Same as NAA |
| | Assumes that CVP is a significant part of the urban and agricultural water supply of users | Assumes CVP as a significant, essential, and irreplaceable part of the urban and agricultural water supply of users | Same as NAA |
| | Assumes increased use of water rights, need to meet water quality standards and fish protection measures, and other measures constrained use of CVP | Assumes that CVPIA impaired ability of CVP to deliver water | Same as NAA |
| | Assumes the need for the 3408(j) study | Assumes implementation of yield increase projects per 3408(j) study | Same as NAA |

**Table DA-1**
**Comparison of Contract Provisions Considered in Alternatives**

| Provision | No Action Alternative<br>Based on PEIS and Interim Contracts | Alternative 1<br>Based on April 2000 Proposal | Alternative 2<br>Based on November 1999 Proposal |
|---|---|---|---|
| | Assumes that loss of water supply reliability would have impact on socioeconomic conditions and change land use | Assumes that loss of water supply reliability would have significant adverse socioeconomic and environmental impacts in CVP service area | Same as NAA |
| **Definitions** | | | |
| **"Charges"** | Charges defined as payments required in addition to Rates | Assumes rewording of definition of Charges to exclude both Rates and Tiered Pricing Increments | Same as NAA |
| **"Category 1 and Category 2"** | Tiered Pricing as in PEIS | Not included | Tiered Pricing for Categories 1 and 2 |
| **"Contract Total"** | Contract Total described as Total Contract | Same as NAA | Described as basis for Category 1 to calculate Tiered Pricing |
| **"Landholder"** | Landholder described in existing Reclamation Law | Assumes rewording to specifically define Landholder with respect to ownership, leases, and operations | Assumes rewording to specifically define Landholder with respect to ownership and leases |
| **"M&I Water"** | Assumes rewording to provide water for irrigation of land in units less than or equal to 5 acres as M&I water unless Contracting Officer satisfied use is irrigation | M&I water described for irrigation of land in units less than or equal to 2 acres | Same as NAA |
| **Terms of Contract - Right to Use Contract** | Assumes that contracts may be renewed | States that contract shall be renewed | Same as NAA |
| | Assumes convertibility of contract to a 9(d) contract same as existing contracts | Includes conditions that are related to negotiations of the terms and costs associated with conversion to a 9(d) contract | Same as NAA |

**Table DA-1**
**Comparison of Contract Provisions Considered in Alternatives**

| Provision | No Action Alternative<br>Based on PEIS and Interim Contracts | Alternative 1<br>Based on April 2000 Proposal | Alternative 2<br>Based on November 1999 Proposal |
|---|---|---|---|
| **Water to be Made Available and Delivered to the Contractor** | Assumes water availability with existing conditions | Similar to NAA | Actual water availability in a year is unaffected by Categories 1 and 2. |
| | Assumes compliance with Biological Opinions and other environmental documents for contracting | Not included | Same as NAA |
| | Assumes that current operating policies strive to minimize impacts to CVP water users | Assumes that CVP operations will be conducted in a manner to minimize shortages and studies to increase yield shall be completed with necessary authorizations | Same as NAA |
| **Time for Delivery of Water** | Assumes methods for determining timing of deliveries as in existing contracts | Assumes minor changes related to timing of submittal of schedule | Same as NAA |
| **Point of Diversion and Responsibility for Distribution of Water** | Assumes methods for determining point of diversion as in existing contracts | Assumes minor changes related to reporting | Same as NAA |
| **Measurement of Water Within District** | Assumes measurement for each turnout or connection for facilities that are used to deliver CVP water as well as other water supplies | Assumes measurement at delivery points | Assumes similar actions in NAA but applies to all water supplies |
| **Rates and Method of Payment for Water** | Assumes Tiered Pricing is total water quantity. Assumes advanced payment for rates for 2 months. | Assumes Tiered Pricing is total water quantity. Assumes advanced payment for rates for 1 month. | Assumes Tiered Pricing is total water quantity. Assumes advanced payment for rates for 6 months. |
| **Non-interest Bearing Operation and Maintenance Deficits** | Assumes language from existing contracts | Same as NAA | Same as NAA |

**Table DA-1**
**Comparison of Contract Provisions Considered in Alternatives**

| Provision | No Action Alternative<br>Based on PEIS and Interim Contracts | Alternative 1<br>Based on April 2000 Proposal | Alternative 2<br>Based on November 1999 Proposal |
|---|---|---|---|
| **Sales, Transfers, or Exchanges of Water** | Assumes continuation of transfers with the rate for transferred water being the higher of the sellers or purchasers CVP cost of service rate | Assumes continuation of transfers with the rate for transferred water being the purchasers CVP cost of service rate | Same as NAA |
| **Application of Payments and Adjustments** | Assumes payments will be applied as in existing contracts | Assumes minor changes associated with methods described for overpayment | Same as NAA |
| **Temporary Reduction - Return Flows** | Assumes that current operating policies strives to minimize impacts to CVP water users | Assumes minor changes associated with methods described for discontinuance or reduction of payment obligations | Same as NAA |
| **Constraints on Availability of Project Water** | Assumes that current operating policies strive to minimize impacts to CVP water users | Assumes Contractors do not consent to future Congressional enactments which may impact them | Same as NAA |
| **Unavoidable Groundwater Percolation** | Assumes that some of applied CVP water will percolate to groundwater | Same as NAA | Same as NAA |
| **Rules and Regulations** | Assumes that CVP will operate in accordance with then existing rules | Assumes minor changes with right to non-concur with future enactments retained by Contractors | Same as NAA |
| **Water and Air Pollution Control** | Assumes that CVP will operate in accordance with then-existing rules | Same as NAA | Same as NAA |
| **Quality of Water** | Assumes that CVP will operate in accordance with existing rules without obligation to operate towards water quality goals | Same as NAA | Same as NAA |

**Table DA-1**
**Comparison of Contract Provisions Considered in Alternatives**

| Provision | No Action Alternative<br>Based on PEIS and Interim Contracts | Alternative 1<br>Based on April 2000 Proposal | Alternative 2<br>Based on November 1999 Proposal |
|---|---|---|---|
| **Water Acquired by the Contractor Other than from the United States** | Assumes that CVP will operated in accordance with existing rules | Assumes changes associated with payment following repayment of funds | Same as NAA |
| **Opinions and Determinations** | PEIS recognizes that CVP will operated in accordance with existing rules | Assumes minor changes with respect to references to the right to seek relief | Same as NAA |
| **Coordination and Cooperation** | Not included | Assumes that coordination and cooperation between CVP operations and users should be implemented and CVP users should participate in CVP operational decisions | Not included |
| **Charges for Delinquent Payments** | Assumes that CVP will operate in accordance with existing rules | Same as NAA | Same as NAA |
| **Equal Opportunity** | Assumes that CVP will operate in accordance with existing rules | Same as NAA | Same as NAA |
| **General Obligation** | Assumes that CVP will operate in accordance with existing rules | Similar to NAA | Same as NAA |
| **Compliance with Civil Rights Laws and Regulations** | Assumes that CVP will operate in accordance with existing rules | Same as NAA | Same as NAA |
| **Privacy Act Compliance** | Assumes that CVP will operate in accordance with existing rules | Same as NAA | Same as NAA |
| **Contractor to Pay Certain Miscellaneous Costs** | Assumes that CVP will operate in accordance with existing rules | Similar to NAA | Same as NAA |

**Table DA-1**
**Comparison of Contract Provisions Considered in Alternatives**

| Provision | No Action Alternative<br>Based on PEIS and Interim Contracts | Alternative 1<br>Based on April 2000 Proposal | Alternative 2<br>Based on November 1999 Proposal |
|---|---|---|---|
| **Water Conservation** | Assumes compliance with conservation programs established by Reclamation and the State | Assumes conditions similar to NAA with the ability to use State standards which may or may not be identical to Reclamation's requirements | Same as NAA |
| **Existing or Acquired Water or Water Rights** | Assumes that CVP will be operated in accordance with existing rules | Same as NAA | Same as NAA |
| **Operation and Maintenance by Non-federal Entity** | Assumes that CVP will operate in accordance with existing rules and no additional changes to operation responsibilities under this alternative | Assumes minor changes to language that would allow subsequent modification of operational responsibilities | Assumes minor changes to language that would allow subsequent modification of operational responsibilities |
| **Contingent on Appropriation or Allotment of Funds** | Assumes that CVP will operate in accordance with existing rules | Assumes minor changes to language | Same as NAA |
| **Books, Records, and Reports** | Assumes that CVP will operate in accordance with existing rules | Assumes changes for record keeping for both CVP operations and CVP users | Same as NAA |
| **Assignment Limited** | Assumes that CVP will operate in accordance with existing rules | Assumes changes to facilitate assignments | Same as NAA |
| **Severability** | Assumes that CVP will operate in accordance with existing rules | Same as NAA | Same as NAA |
| **Resolution of Disputes** | Not included | Assumes a Dispute Resolution Process | Not included |
| **Officials Not to Benefit** | Assumes that CVP will operate in accordance with existing rules | Same as NAA | Same as NAA |

**Table DA-1**
**Comparison of Contract Provisions Considered in Alternatives**

| Provision | No Action Alternative<br>Based on PEIS and Interim Contracts | Alternative 1<br>Based on April 2000 Proposal | Alternative 2<br>Based on November 1999 Proposal |
|---|---|---|---|
| **Changes in Contractor's Service Area** | Assumes no change in CVP water service areas absent Contracting Officer consent | Assumes changes to limit rationale used for non-consent and sets time limit for assumed consent | Same as NAA |
| **Notices** | Assumes that CVP will operate in accordance with existing rules | Same as NAA | Same as NAA |
| **Confirmation of Contract** | Assumes Court confirmation of contract | Not included - Assumption is Court confirmation not required | Same as NAA |

**Table DA-2**
**Summary of Potential Impacts**

| Resources | No Action Alternative | Alternative 1 | Alternative 2 |
|---|---|---|---|
| **Surface Water** | Based on the conjunctive use design of the Friant Division, Contractors are expected to continue mixed use of CVP surface water and ground water, with greater emphasis on ground-water use during dry periods when CVP surface water is limited. | Similar effect as the NAA. | Little or no change in surface water use is anticipated for most year types. The largest change is in subarea 13 (Madera ID and Gravely Ford ID) for wet years following a dry five-year period shifting from surface water to ground water. Based upon cost, approximately 113,100 af less surface water would delivered in this subregion for this specific combination of years. Water may remain in Millerton Lake until purchased by another contractor or could be spilled. This would potentially result in a change in the timing of some of the releases to the two canals. The operation of Buchanan Dam and Hidden Dam will not change with this alternative. |
| **Water Supply** | Historic operation of the Friant-Kern Canal, Madera Canal, Millerton Lake, Hensley Lake, and Eastman Lake will remain the same under the NAA relative to historic conditions. The conjunctive use of ground water and surface water is not expected to change under the provisions of the NAA. | Similar effect as the NAA. | Minimal changes are anticipated for irrigated acres in most year types for most of the subbasins. In most of the combinations of years simulated in CVPM, there was little or no change in surface and ground water use relative to the NAA. Flood control releases that have historically been made down the Friant-Kern and Madera Canals will continue. |

**Table DA-2**
**Summary of Potential Impacts**

| Resources | No Action Alternative | Alternative 1 | Alternative 2 |
|---|---|---|---|
| | | | Redistribution of surface water and ground water usage in certain years because of tiered water pricing is anticipated. These effects reflect a redistribution of water supplies for one-year periods and not a long-term shift in water supply. Overall, the water supply is still available to the contractors and will be used in the Division. There is no impact to surface water. |
| **Ground Water** | During dry conditions, ground water usage increases in response to decreases in surface water supplies. Contractors return to greater surface water usage after the dry condition end. | Similar effect as the NAA. | In most areas, a single year of substantially increased ground water pumping is unlikely to critically affect ground water elevations. The long-term effect of increases and decreases in ground water pumping is unknown at this time because water users may respond differently than predicted in the model. |
| **Water Quality** | Water quality in the rivers and ground water of the Friant Division is not anticipated to change significantly from past conditions. Factors that tend to influence water quality, such as agricultural runoff, will be similar to historic conditions. Because ground water quality is influenced by factors such as deep percolation of applied water, a shift in the quality of applied water may change the ground water quality. | Similar effect as the NAA. | The long-term effect of increases and decreases in ground water pumping is unknown at this time because water users may respond differently than predicted in the model. It is unknown if other years with decreased ground water pumping would offset this increase over the long term. Depending on the geographic areas where the pumping would increase, the quality of the water used for irrigation may be less than |

**Table DA-2**
**Summary of Potential Impacts**

| Resources | No Action Alternative | Alternative 1 | Alternative 2 |
|---|---|---|---|
| | | | the quality of the surface water available under the NAA. |
| **Fisheries** | Water use is expected to continue as it has using both CVP surface water supplies and ground water. Ground water has typically been more important during dry years when CVP water is less available. | Similar effect as the NAA. | Any redistribution of water not purchased depends on many factors. It could result in more water being released into the Friant-Kern or Madera canals, more water stored in Millerton Lake, or more water released into the San Joaquin River.<br><br>Water would remain in Millerton Lake until purchased by Firant users. Water not purchased would likely be picked up by other users. This could result in different timing in the movement of water in the canals. |
| **Land Use** | Changes in irrigated acres are relatively small because of the high percentage of land in the subregions planted in permanent crops and the availability of ground water as a replacement for decreased CVP supplies. | Similar effect as the NAA. | The greatest reduction in irrigated acreage, is when a wet year follows a series of dry years. Even so, the 2,700 acre reduction represents a reduction of only 0.1 percent over the NAA wet year acreage of 1,058.2 acres. The analysis of M&I use of CVP water shows that there is no reduction in deliveries. |

**Table DA-2**
**Summary of Potential Impacts**

| Resources | No Action Alternative | Alternative 1 | Alternative 2 |
|---|---|---|---|
| **Biological** | Existing Friant Division management will continue under current conditions. No impacts to vegetation and wildlife are expected, since no additional infrastructure (*e.g.*, dams, increased dam heights, canals, etc.) will be constructed. Additionally, under this alternative, there will be no increase in deliveries and no conversion of existing natural habitat into farmland. | Similar effect as the NAA. | The additional water cost could result in an increase in the amount of lands left fallow. If fallowed lands are restored to native conditions, they could provide habitat for regional vegetation and wildlife.<br><br>A decrease in some agricultural crops (e.g., alfalfa and grain crops) however, could potentially impact the amount of nesting and feeding habitat for wildlife in the area. While a reduction in the amount of alfalfa or grain acreage could impact some species, restoration of these lands to a more natural condition would likely provide benefits to listed and other species considered sensitive.<br><br>As the cost of water increases, the opportunity to provide wetland habitat by private landowners generally decreases. This could result in a decrease in availability of wetland habitat in the Friant Division region. However, if water use decreases, more water may be available to flow down the San Joaquin, Chowchilla, and Fresno Rivers. Increased flows along these waterways would enhance the riparian zones, resulting in enhanced habitat quality for wildlife. |

**Table DA-2**
**Summary of Potential Impacts**

| Resources | No Action Alternative | Alternative 1 | Alternative 2 |
|---|---|---|---|
| **Recreational** | The operation of CVP facilities does not change and reservoirs and the recreational resources is not changed. | Similar effect as the NAA. | Similar to the NAA. |
| **Socioeconomic** | The NAA will have a less than significant effect on economic resources. The largest variations seen in irrigated acres, gross revenue, net revenue, and employment in the region change with the weather and commodity demands. The change in irrigated acres from an Average Year to a Dry Year decreases by two percent. The change in gross revenue between an Average Year to a Dry Year decreases by one percent. In Wet Years net income decreases by one percent. The change in employment from an Average Year to a Dry Year decreases by less than one percent. | Similar effect as the NAA. | Similar to the NAA, the alternative will have a minor effect. The change in irrigated acres from an Average Year to a Dry Year decreases by less than one percent. The change in gross revenue decreases by one percent in all scenarios. Net income decreases less than one percent. The change in regional employment decreases by less than one percent. |
| **Cultural** | The NAA would not result in direct impact to eligible or significant cultural resources. Water apportioned under the NAA may be used to alter the use of a landscape, either through inundation, irrigation-related construction, or some other change which could impact cultural resources. The entities responsible at this level for potential impacts to cultural resources are the counties, except Fresno County, where the contracting agencies – the individual water districts, have the responsibility. | Similar effect as the NAA. | Similar to the NAA. |

**Table DA-2**
**Summary of Potential Impacts**

| Resources | No Action Alternative | Alternative 1 | Alternative 2 |
|---|---|---|---|
| **Social Conditions** | The operation of the CVP facilities do not change and the social conditions are not changed. | Similar effect as the NAA. | Similar to the NAA. |
| **Air Quality** | The operation of CVP facilities does not change and air quality does not change. | Similar effect as the NAA. | Similar to the NAA. |
| **Geology and Soils** | The operation of CVP facilities and reservoirs does not change and the soil and geology resources are not changed. | Similar effect as the NAA. | To reduce soil erosion, retired or fallowed land are assumed to have cover crop planted in the last year of cultivation. |
| **Visual** | The CVP facilities and reservoirs do not change and the visual resources do not change. | Similar effect as the NAA. | Similar to the NAA. |

SECTION 3

# AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

## INTRODUCTION

This section presents the existing conditions for the environmental resource topics and discusses the impacts expected to occur as a result of implementing the LTCRs. The environmental consequences are provided for the NAA and Alternatives l and 2 considered in the study area as described under the affected environment. The period of analysis was conducted for the projected conditions in the Year 2026, the first period of renewal for the 25-year LTCRs. Considering the purpose of this project is to renew long-term water service contracts, the resource areas considered relevant and appropriate for the EA included the following:

- Surface Water
- Water Supply
- Ground Water Resources
- Water Quality
- Fisheries Resources
- Land Use Resources
- Biological Resources
- Recreational Resources
- Socioeconomic Resources
- Cultural Resources
- Social Conditions
- Air Quality
- Geology and Soils
- Visual Resources

## SURFACE WATER

### Affected Environment

The Friant Division of the CVP includes facilities to collect and convey water from the upper San Joaquin River watershed to areas along the east side of the southern San Joaquin Valley from approximately Chowchilla on the north to the Tehachapi Mountains on the south. Located in the southern San Joaquin River Basin and the Tulare Basin, the major facilities of the Friant Division include Friant Dam and Millerton Lake, the 36 mile-long Madera Canal, and the 152 mile-long Friant-Kern Canal. Friant Dam impounds and diverts the San Joaquin River forming Millerton Lake. Other facilities that supply water to the Friant Unit include Buchanan Dam and Hidden Dam on the Chowchilla and Fresno rivers, respectively.

Water is delivered from Millerton Lake to contracting irrigation and water districts and local cities to the south via the Friant-Kern Canal and to the north via the Madera Canal. The CVP water delivery to this region augments ground water and local surface water supplies in an area that has been historically subject to reductions in ground-water elevation during dry periods. Although the Friant Division is an integral part of the CVP, it is hydrologically independent and operates separately from the northern and southern CVP systems.

***Upper San Joaquin River***

Runoff from the Sierra Nevada mountains east of the San Joaquin Valley occurs between late winter to early summer and fall. Above Friant Dam, the San Joaquin River drains an area of approximately 1,676 square miles and has an annual average unimpaired runoff of 1.7 million af/yr. The historical unimpaired runoff ranges from 0.4 to 4.6 million acre-feet per year with a median of 1.4 million af/yr. There are seven reservoirs in the upper portion of the San Joaquin River watershed, including Mammoth Pool and Shaver Lake, that are primarily used for hydroelectric power generation and have a combined storage capacity of approximately 620,000 acre-feet per year.

The majority of the annual flow of the San Joaquin River at Friant Dam has been diverted in the Friant-Kern and Madera Canal with peak monthly flows occurring in July. Average monthly releases from Friant Dam to the San Joaquin River, since 1941, have included minimum releases to satisfy water rights above Gravelly Ford and flood control releases with minor contributions from agricultural and urban return flows (Figure SW-1).

However, the recent San Joaquin River Riparian Flow Pilot Project test program has increased flows of the San Joaquin River between Friant Dam and Mendota Pool to provide benefits to riparian habitat. The pilot project has introduced enhanced riparian flows into reaches of the San Joaquin River that typically carry minimal flow. The limited flows below Friant Dam, which began July 3 1999, represent a one-time release into the channel that separates Fresno and Madera counties. As envisioned, the pilot project was a five-month water management regimen. Friant Division districts made approximately 35,000 af of water available for the pilot program in 1999. In addition, Reclamation approved the purchase and delivery of up to 15,000 af of CVP supplies as "replacement water" to make up for potentially significant river channel conveyance losses incurred between Friant Dam and Mendota Pool. The replacement water was also conveyed through the California Aqueduct for delivery into the Friant service area via the Cross Valley Canal. The project was contingent upon water exchanges to ensure no adverse impacts to Friant water users' supplies. A similar project was conducted in 2000.

The 2000 pilot program utilized Class 2 water to recharge ground-water basins and took delivery of Class 1 water for the program. Several irrigation districts in the Friant Unit received Class 2 water during May 2000 and used it to recharge the ground water. Later, this water was pumped and used for irrigation in lieu of Class 1 water. About 1.5 af was recharged for every 1.0 af pumped. About 11,263 af were used for the project (URS 2000).

**San Joaquin River Below Friant Dam**
**Average Monthly Flow**
**(cfs)**

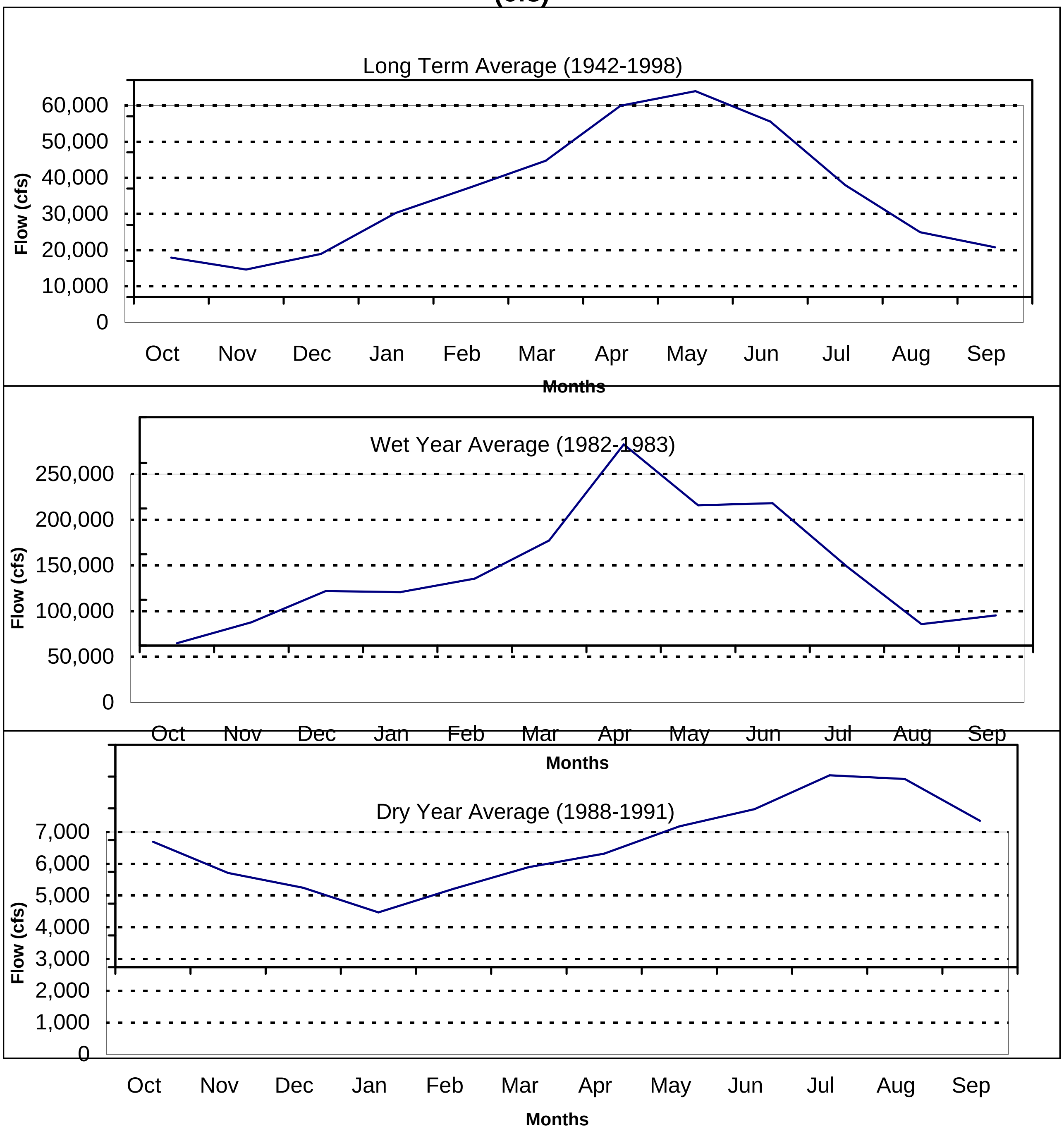



Figure SW-1
Average Monthly Flow of San Joaquin River
Below Friant Dam

***San Joaquin River between Gravelly Ford and Fremont Ford***

Gravelly Ford, located downstream of Friant Dam, is a sandy and gravelly section of the San Joaquin River that is subject to high river flow losses. The section of the San Joaquin River between Gravelly Ford and Mendota Pool spans approximately 17 miles and is generally dry except when releases are made from Friant Dam for flood control.

During flood control operations, flood flows can be diverted to the Chowchilla Bypass up to its capacity of 6,500 cfs. The Chowchilla Bypass runs northwest, intercepts flows in the Fresno River, and discharges to the Chowchilla River. The East Side Bypass begins at the Chowchilla River and runs northwesterly to rejoin the San Joaquin River above Fremont Ford. Together, the Chowchilla and Eastside bypasses intercept flows of the San Joaquin, Fresno, and Chowchilla rivers, and other lesser east side San Joaquin River tributaries, to provide flood protection for downstream agricultural lands. These bypasses are located in highly permeable soils, and much of the water recharges ground water.

Flows in the San Joaquin River that pass the Chowchilla Bypass enter Mendota Pool. Mendota Pool was formed in 1871 by the construction of Mendota Dam on the San Joaquin River by water rights holders, and is the point at which the San Joaquin River turns northward. Mendota Pool has a capacity of approximately 50,000 af/yr and serves as a forebay for diversions to the Main and Outside canals. The Delta-Mendota Canal, which conveys CVP water from the Delta to CVP contractors, terminates at Mendota Pool. Water also enters Mendota Pool from the south, via Fresno Slough (sometimes referred to as James Bypass), which conveys overflows from the Kings River in the Tulare Lake Basin to the San Joaquin River.

***Millerton Lake***

Millerton Lake is formed by Friant Dam and has a capacity of 520,000 af. The Lake serves both as a flood control facility and a water supply facility. Operations are coordinated with upstream hydroelectric utility-owned reservoirs and the Army Corp of Engineers (COE). Up to 390,000 af per year of Millerton Lake is reserved for flood control storage. Part or all of the dedicated flood control storage may be used for conservation storage, depending on the time of year and the current flood hazard. Flood control operations of Millerton Lake are influenced by the storage available in upstream reservoirs (Figure SW-2).

Flood control releases from Millerton Lake may be used to satisfy portions of deliveries to the Mendota Pool Contractors and the San Joaquin River Exchange Contractors on the San Joaquin River below Mendota Pool. Millerton Lake operations are coordinated with operations of the Delta-Mendota Canal in the Delta Division to use all available Millerton Lake flood control releases before additional water is delivered to Mendota Pool. Millerton Lake is operated to fill in the spring after the flood control requirements are lifted and to be reduced to a base level by fall. Typically, water is not carried over in Millerton Lake as it is in other CVP reservoirs.

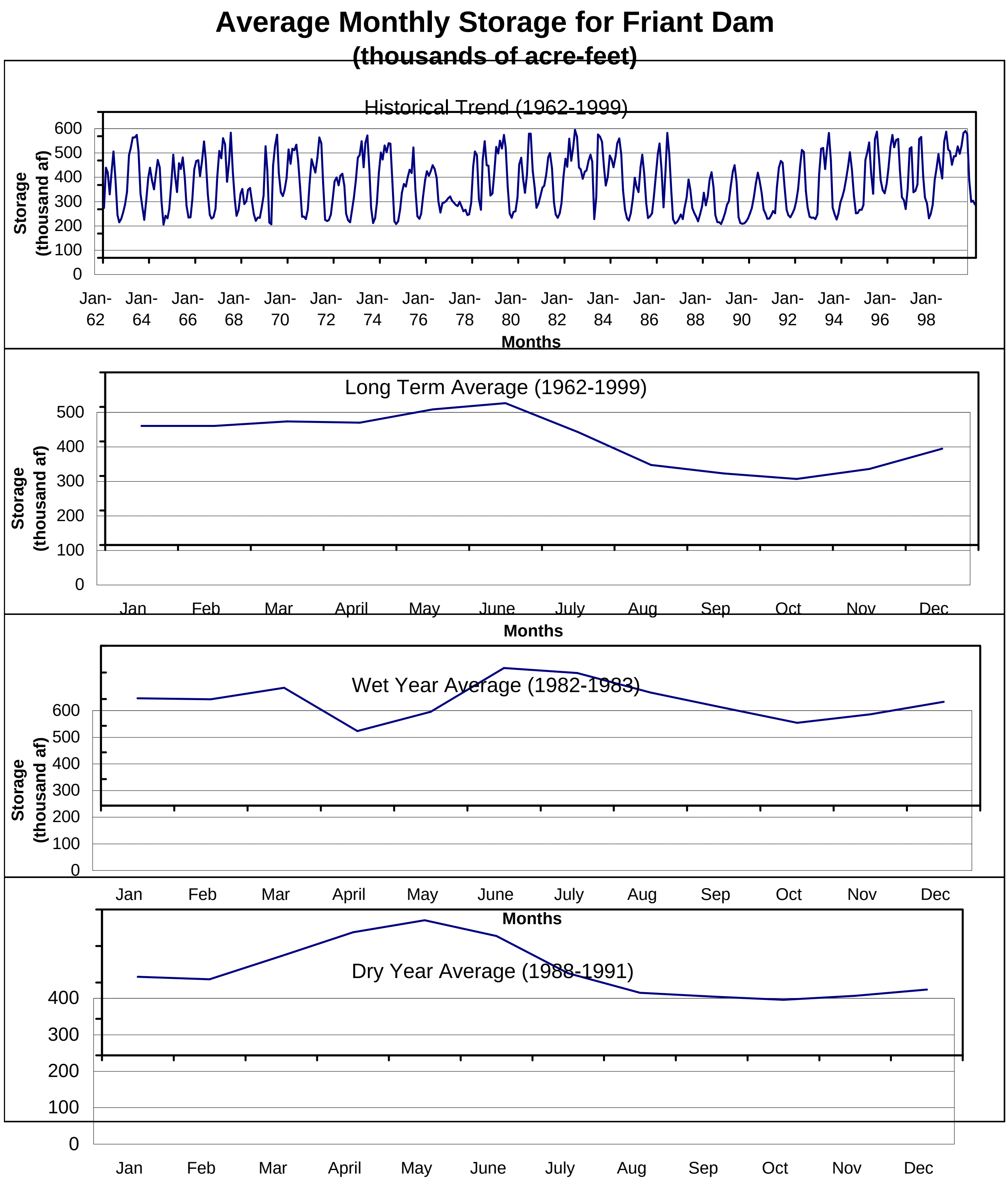



Figure SW-2
Average Monthly Storage for Millerton Lake

The determination of annual water supply from the Friant Division is done independently from other CVP divisions. On February 15 of each year, Reclamation provides Friant contractors with an estimate of the water supply for the coming contract year based on hydrological conditions, water supply storage in upstream reservoirs, and assumptions based on statistical analysis of historic records. This estimate is revised monthly or sometimes more frequently throughout the contract year.

***Friant-Kern and Madera Canal***

Since completion of Friant Dam in 1941, the majority of the annual San Joaquin River flow has been diverted to the 152 mile-long Friant-Kern Canal and the 36 mile-long Madera Canal. Millerton Lake storage is used to furnish an average annual supplemental canalside water supply of about 800,000 af of Class 1 and about 1,400,000 af of Class 2 water to both the Friant-Kern and Madera canals.

The Madera Canal extends north from Friant Dam to Ash Slough on the Chowchilla River in Madera County. The Canal diverts water to supply lands in the Madera Irrigation District and Chowchilla Water District with a supplemental irrigation supply. A portion of the water supply to the Madera Canal service area is supplied through the integrated operation of Hidden Dam on the Fresno River and Buchanan Dam on the Chowchilla River, which are included in the Eastside Division of the CVP. Both Buchanan and Hidden dams are operated by the U.S. Army Corps of Engineers, and their operations are coordinated with CVP operations in the Friant Division.

The Friant-Kern Canal extends south from Friant Dam to the Kern River near Bakersfield. The Canal diverts water to extensive areas in the Tulare Lake Basin, that lack or are deficient in water supplies. Individual irrigation districts integrate CVP water supplies with water supplies from the Kings, Kaweah, Tule, and Kern rivers and through exchange agreements between Friant-Kern and Cross Valley Canal contractors.

***Chowchilla River***

The Chowchilla River, a tributary to the San Joaquin River, drains a watershed of approximately 236 square miles in the Sierra Nevada. Because of the relatively low elevation of the watershed, most of the flow in the Chowchilla River results from rainfall. Historically, the Chowchilla River has behaved as an ephemeral stream with large winter floodflows and near zero summertime flows (Figure SW-3). The Chowchilla River ultimately discharges into the East Side Bypass.

## Chowchilla River Below Buchanan Dam
## Average Monthly Flow
## (cfs)

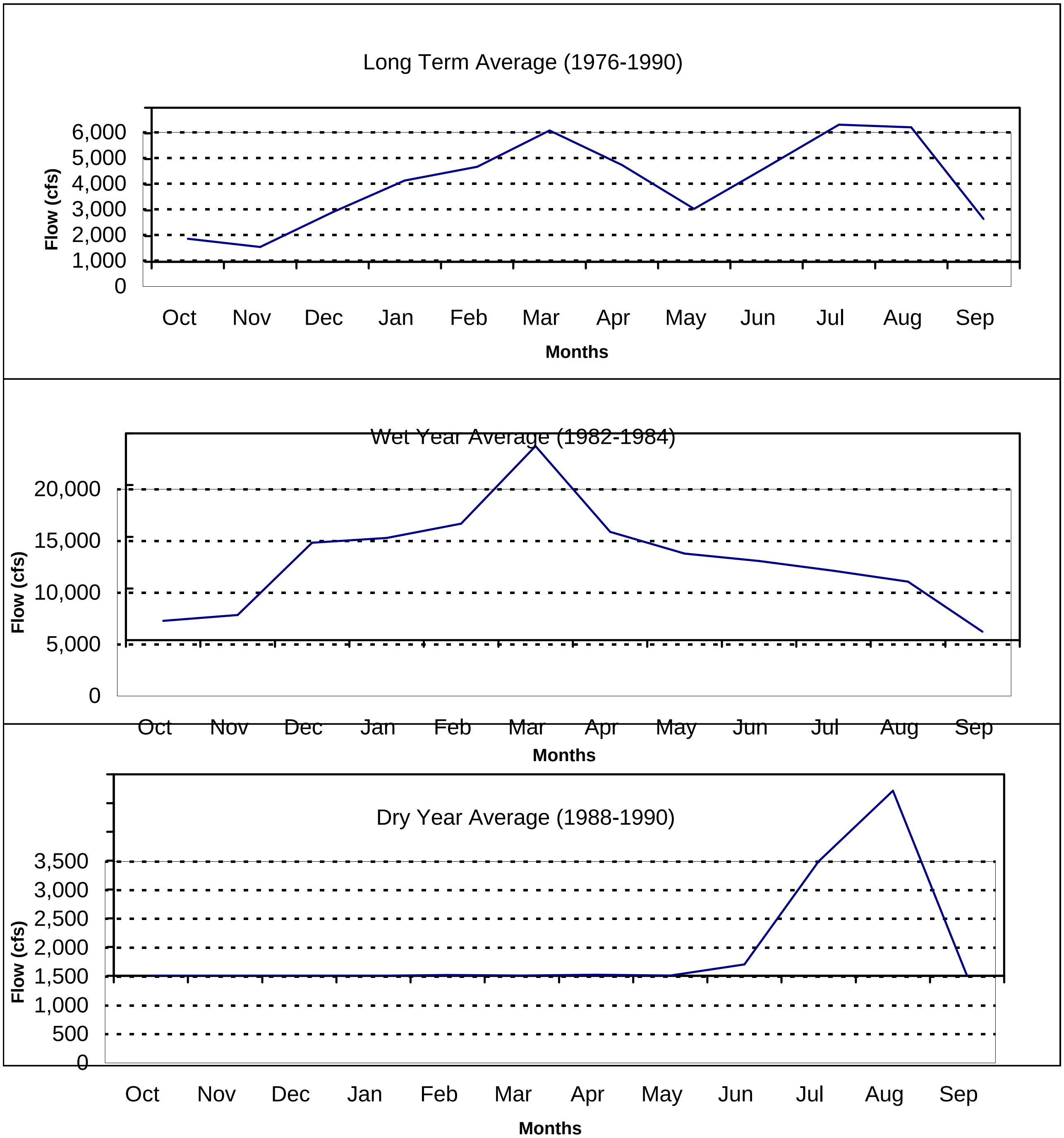



Figure SW-3
Average Monthly Flow of Chowchilla River
Below Buchanan Dam

Located on the Chowchilla River, Buchanan Dam and Eastman Lake is the only regulating reservoir on the river. Buchanan Dam was completed and operational in 1976 and has a maximum storage capacity of 150,600 af. The reservoir is operated to fill and empty each year. Releases are made directly to the river (Figure SW-4). The U.S. Army Corps of Engineers operates Buchanan Dam, and releases are coordinated with Reclamation operations at Friant Dam. Generally, supplies from Madera Canal supplement direct diversions from the Chowchilla River. Releases from Buchanan Dam help meet the supplemental water demand. During flood control operations, Madera Canal spills can be released down Ash and Berenda sloughs, approximately 10 miles downstream of Buchanan Dam.

***Fresno River***

The Fresno River is a tributary to the San Joaquin River that drains a watershed of approximately 237 square miles in the Sierra Nevada foothills. Because of the relatively low elevation of the watershed, most of the flow in the Fresno River results from rainfall. Historically, the Fresno River has behaved as an ephemeral stream with large winter flood flows and near zero summertime flows. The Fresno River ultimately discharges into the East Side Bypass (Figure SW-5).

Located on the Fresno River, Hidden Dam and Hensley Lake are the only regulating facilities on the river. Hensley Dam was completed and operational in 1975 and impounds a lake with a maximum storage capacity of 85,200 af. The COE operates Hidden Dam, and river releases are coordinated with Reclamation operations at Friant Dam.

Madera Canal, which conveys water northwest from Friant Dam, crosses the Fresno River approximately 3 miles downstream from Hidden Dam. Deliveries from Madera Canal to CVP contractors can be made via the Fresno River, as are flood spills during flood control operations. (Figure SW-6).

## Environmental Consequences

Potential environmental effects of the project include changes in surface water flows because of changes in the amount of CVP water purchased on an annual basis. These potential effects are discussed below. Flood control operations at Friant, Buchanan, and Hidden dams will continue as required by the COE established rule curves for each facility and will not change because of this project. As such, no changes in water capture or release are expected under any of the alternatives considered during the period the flood rule curves are in effect each year.

# Average Monthly Storage for Eastman Lake

**(thousands of acre-feet)**

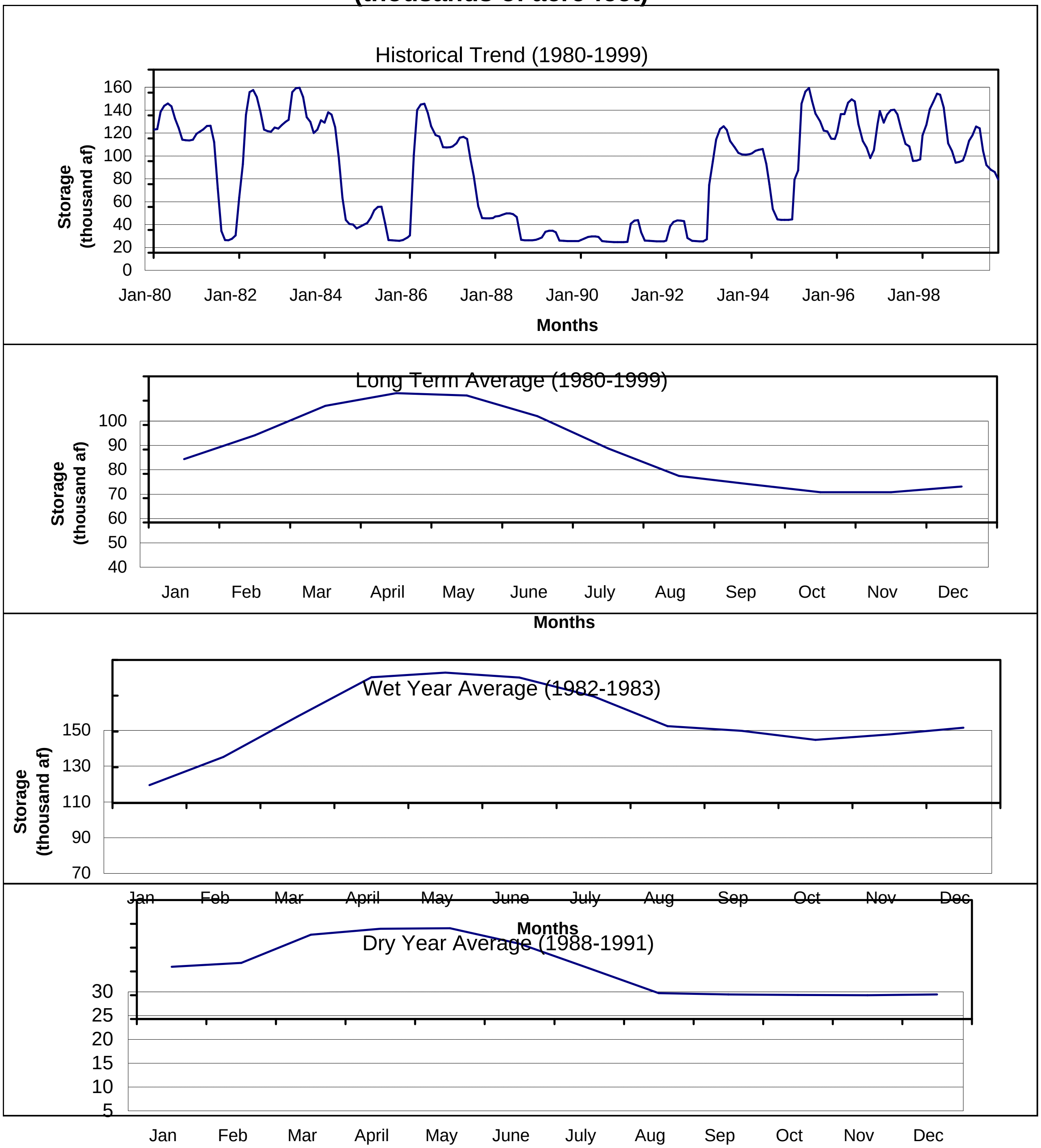



Figure SW-4
Average Monthly Storage for Eastman Lake

**Fresno River Below Hidden Dam**
**Average Monthly Flow**
**(cfs)**

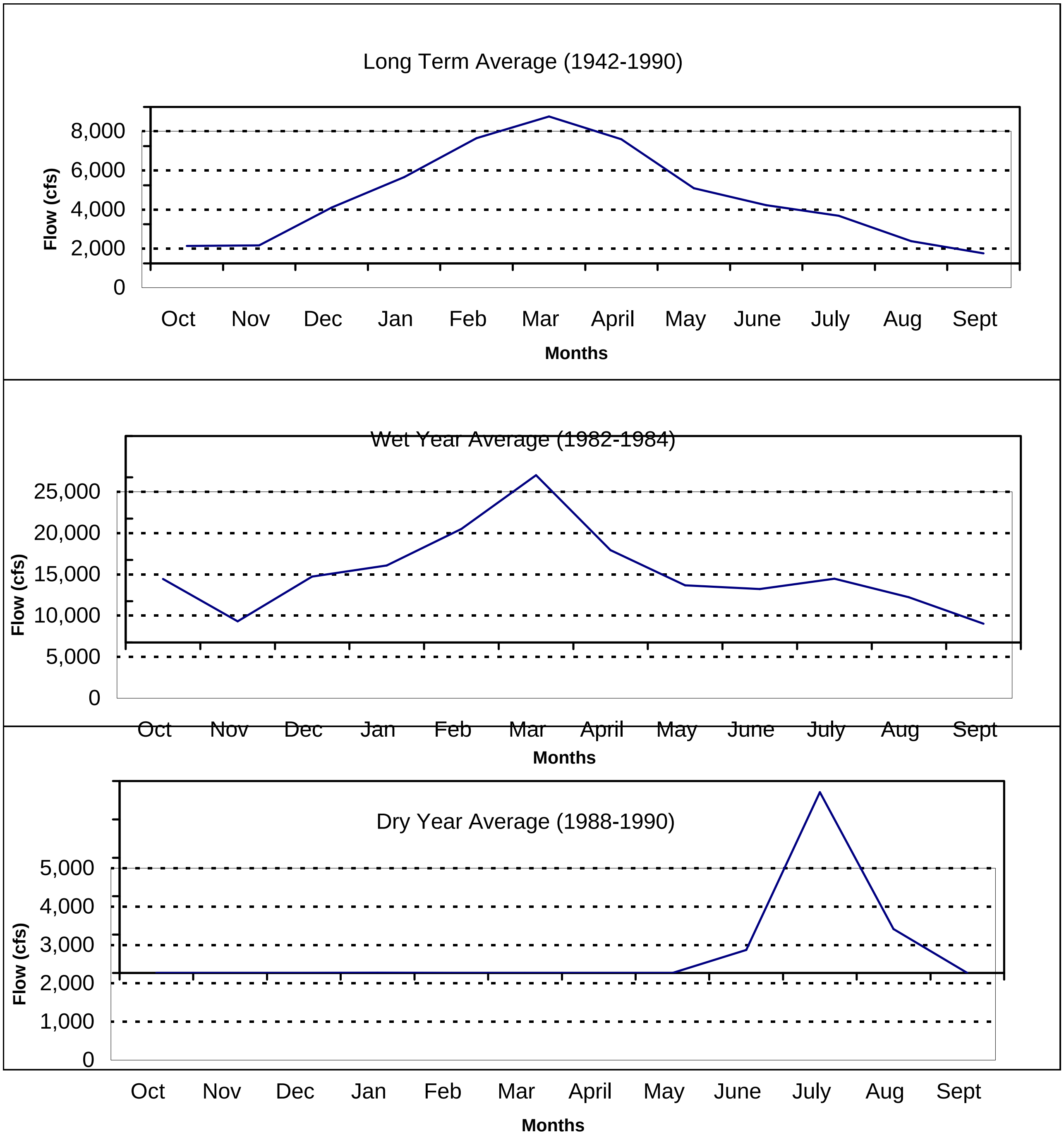



Figure SW-5
Average Monthly Flow of Fresno River
Below Hidden Dam

## Average Monthly Storage for Hensley Lake
**(thousands of acre-feet)**

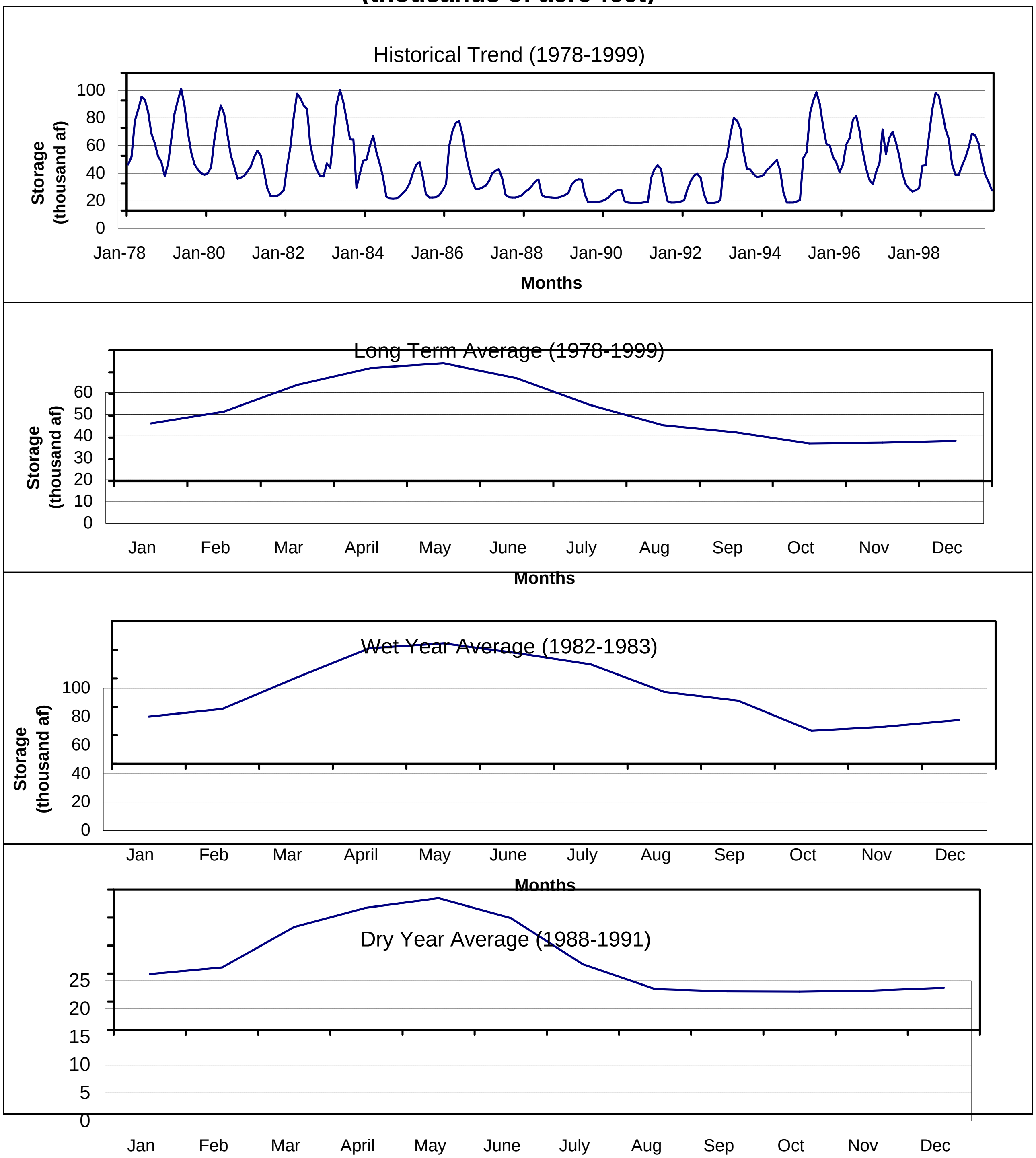



Figure SW-6
Average Monthly Storage for Hensley Lake

***No Action Alternative***

Based on the conjunctive use design of the Friant Division, Contractors are expected to continue mixed use of CVP surface water and ground water, with greater emphasis on ground-water use during dry periods when CVP surface water is limited. The surface water resources of the San Joaquin River under the NAA are discussed in the Preferred Alternative of the PEIS (Reclamation 1999).

***Alternative 1***

Alternative 1 is similar to the NAA in terms of environmental effects. Therefore, there are no effects to surface water under this alternative.

***Alternative 2***

A blended water pricing structure for CVP water evaluated under Alternative 2 is based on a five-year running average of delivered water. An economic analysis of this alternative showed that, during some periods, contractors will purchase less CVP water and rely more on ground water (CH2M Hill 2000). Table WS-3 of the Water Supply Section details the results of the economic analysis. Little or no change in surface water use is anticipated for most year types. The largest change from the NAA is in subarea 13 (Madera ID and Gravely Ford ID) for wet years following a dry five-year period. The analysis shows a shift from surface water to ground water, based on cost of water. Approximately 113,100 af less surface water would be diverted in this subregion for this specific combination of years. This water would remain in Millerton Lake until purchased by another contractor. This would potentially result in a change in the timing of some of the releases to the two canals.

It is speculative where and when the water not purchased in subarea 13 would go but given the current and anticipated irrigation shortfall the water would be used. The water not used in subarea 13 could potentially be retained in Millerton Lake until it was purchased by another user. Millerton Lake could potentially remain at higher storage under this condition, but this change would be temporary until the water was purchased by another contractor. Under current operations, the water would not be carried over to the following year.

The operations of Buchanan Dam and Hidden Dam will not change with this alternative. The reservoirs will fill and spill based on the availability of water in the basins. The flood control operations of Millerton lake will not change because of this alternative.

## Cumulative Effects

The cumulative effect of all foreseeable projects will be to place additional demands on the available water supply. Also, the restoration projects may result in additional flows in local rivers for habitat restoration. Implementation of Alternative 1 or 2 will not influence the cumulative effects of other projects to surface water resources.

# WATER SUPPLY

## Affected Environment

### *Friant Division Contractors*

The Friant Division was designed to support the conjunctive use of surface water and ground water that has long been a major component in the management of water supplies in the San Joaquin River and Tulare Lake basins. To support the management of conjunctive use, a two-class system of water service contracts is employed in the Friant Division (Table WS-1). Class 1 contracts are typically assigned to M&I users and agricultural districts with limited access to good quality ground water. Class 1 water is available in most years and is considered to be a dependable supply.

Class 2 water is that supply that may be available in addition to Class 1 water and is only available in the full contract amount during wet years. Class 2 contracts are generally held by agricultural water users that have access to good quality ground water that can be used during periods of surface water deficiency. Ground water recharge and recharge/exchange agreements are frequently used in the management of Class 2 water supplies. On average only about 40 percent of the total Class 2 contract supply is available to contractors.

**Table SW-1**
**CVP Friant Division Class 1 and 2 Contractual Entitlements**

| Friant Division | Class 1 (acre-feet/year) | Class 2 (acre-feet/year) | Historical Maximum Delivery Class 1/Class 2 (acre-feet/year) |
|---|---|---|---|
| Arvin-Edison Water District | 40,000 | 311,675 | 40,000 / 311,675 |
| Chowchilla Water District | 55,000 | 160,000 | 55,000 / 160,000 |
| County of Madera | 200 | 0 | 200 / 0 |
| Delano-Earlimart Irrigation District | 108,800 | 74,500 | 108,800 / 74,500 |
| Exeter Irrigation District | 11,500 | 19,000 | 11,500 / 19,000 |
| City of Fresno | 60,000 | 0 | -- |
| Fresno County Waterworks #18 | 150 | 0 | 150 / 0 |
| Fresno Irrigation District | 0 | 75,000 | 0 / 75,000 |
| Garfield Water District | 3,500 | 0 | 3,500 / 0 |
| Gravelly Ford Water District | 14,000 | 0 | 14,000 / 0 |
| International Water District | 1,200 | 0 | 1,200 / 0 |
| Ivanhoe Irrigation District | 7,700 | 7,900 | 7,700 / 7,900 |
| Lewis Creek Water District | 1,450 | 0 | 1,450 / 0 |
| Lindmore Irrigation District | 33,000 | 22,000 | 33,000 / 22,000 |
| City of Lindsay | 2,500 | 0 | -- |
| Lindsay-Strathmore Irrigation District | 27,500 | 0 | 27,500 / 0 |

**Table SW-1**
**CVP Friant Division Class 1 and 2 Contractual Entitlements**

| Friant Division | Class 1 (acre-feet/year) | Class 2 (acre-feet/year) | Historical Maximum Delivery Class 1/Class 2 (acre-feet/year) |
|---|---|---|---|
| Lower Tule River Irrigation District | 61,200 | 238,000 | 61,200 / 238,000 |
| Madera Irrigation District | 85,000 | 186,000 | 85,000 / 186,000 |
| City of Orange Cove | 1,400 | 0 | 1,045 / 0 |
| Orange Cove Irrigation District | 39,200 | 0 | 39,200 / 0 |
| Porterville Irrigation District | 16,000 | 30,000 | 16, 000 / 30,000 |
| Saucelito Irrigation District | 21,200 | 32,800 | 21,200 / 32,800 |
| Shafter-Wasco Irrigation District | 50,000 | 39,600 | 50,000 / 39,600 |
| Southern San Joaquin Municipal Utility District | 97,000 | 50,000 | 97,000 / 50,000 |
| Stone Corral Irrigation District | 10,000 | 0 | 10,000 / 0 |
| Tea Pot Dome Water District | 7,500 | 0 | 7,500 / 0 |
| Terra Bella Irrigation District | 29,000 | 0 | 29,000 / 0 |
| Tulare Irrigation District | 30,000 | 141,000 | 30,000 / 141,000 |

Source: U.S. Department of Interior, Bureau of Reclamation

### *Criteria for Deliveries to CVP Contractors in the Friant Division*

Millerton Lake is formed behind Friant Dam and has a capacity of 520,000 af. Up to 390,000 af/yr of Millerton Lake is reserved for flood control storage. Part or all of the dedicated flood control storage may be used for conservation storage, depending on the time of year and the current flood hazard. Flood control operations of Millerton Lake are influenced by the storage available in upstream reservoirs. Flood control releases from Millerton Lake may be used to satisfy portions of deliveries to the Mendota Pool Contractors on the San Joaquin River and contractors along the Friant-Kern and Madera canals. Flood control releases are not part of the Class 1 or Class 2 system but are coordinated with water users to achieve maximum utilization of the water.

The determination of annual water supply from the Friant Division is done independently from other CVP divisions. On February 15 of each year, Reclamation provides Friant contractors with an estimate of the water supply for the coming contract year based on hydrological conditions, water supply storage in upstream reservoirs, and assumptions based on statistical analysis of historic records. This estimate is revised monthly throughout the contract year.

### *Ground Water Supplies*

Ground water is a major component of the water supply in the Friant Division. The ground water resources of the region are described in the Ground Water section of this report. These supplies were used conjunctively with surface water.

## Environmental Consequences

Changing the price structure of water delivered to Friant Division contractors could influence the amount of CVP water purchased by an individual district in a given year. Changes in delivery of CVP water influence Millerton Lake storage that is available for water supply. The potential environmental effects are described below.

### *No Action Alternative*

It is assumed that the historic operation of the Friant-Kern Canal, Madera Canal, Millerton Lake, Hensley Lake, and Eastman Lake will remain the same under the NAA relative to historic conditions. Water stored in the three reservoirs will be fully utilized by the end of the irrigation season. During dry periods, when contract water supplies are reduced, contractors who are able to shift to ground water are expected to utilize this source of water supply. This conjunctive use of ground water and surface water is not expected to change under the provisions of the NAA.

Reclamation prepared water needs assessments for the districts within the Friant Division to evaluate the water supply needs in the future (2026). This analysis resulted in an estimate of about 577,384 af of unmet demand in 2026 (Table WS-2). That is, there is an additional need for water in the Friant Division, independent of this project.

**Table WS-2**
**Water Needs Assessments**

| Friant Division Contractor | Unmet Demand (acre-feet/year) | Friant Division Contractor | Unmet Demand (acre-feet/year) |
|---|---|---|---|
| Arvin-Edison WSD | 57,648 | Lower Tule River ID | 23,318 |
| California DFG | 10 | Madera, County of | 200 |
| Chowchilla WD | 68,287 | Madera ID | 97,481 |
| Delano-Earlimart ID | 1,562 | Orange Cove, City of | 1,400 |
| Exeter ID | 13,945 | Orange Cove ID | 30,352 |
| Fresno, City of | | Porterville ID | 11,938 |
| Fresno County WW District #18 | 150 | Saucelito ID | 14,204 |
| Fresno ID | 5,035 | Shafter-Wasco ID | 3,195 |
| Garfield WD | 3,500 | Southern San Joaquin MUD | 30,398 |
| Gravelly Ford WD | 5,257 | Stone Corral ID | 7,541 |
| International WD | 1,200 | Tea Pot Dome WD | 4,434 |
| Ivanhoe ID | 13,687 | Terra Bella ID | 16,157 |
| Lewis Creek WD | 1,450 | Tulare ID | 109,010 |
| Lindmore ID | 19,498 | | |
| Lindsay, City of | 1,501 | **Total** | 557,384 |
| Lindsay-Strathmore ID | 15,026 | | |

Source: U.S. Department of Interior, Bureau of Reclamation

Note: If the Unmet Demand is within 25 percent of the contract supply for contracts of 5,000 to 20,000 acre-feet, then it is assumed that the “surplus”increment can be put to beneficial use. If the Unmet Demand is within 10 percent of the contract supply for the contracts greater than 20,000 acre-feet, then it is assumed that the “surplus” increment can be put to beneficial use. For contracts less than 5,000 acre-feet, it was determined that the full amount could be put to beneficial use and a needs assessment was not done.
A positive unmet demand indicates more demand than supply. Conversely, a negative number indicates more supply than demand.

### *Alternative 1*

The environmental effects of Alternative 1 are similar to the NAA.

### *Alternative 2*

The economic conditions and water use under this alternative were analyzed with the CVPM model (see Socioeconomics Section). The analysis summarized the changes in irrigated acreage by subbasin as compared to irrigated acreage under the NAA. The results for the subbasins relevant to the Friant Division are summarized in Table WS-3. This particular analysis illustrates that minimal changes are anticipated for most year types for most of the subbasins. The water users that are included in the relevant CVPM subbasins are listed in Table WS-4.

**Table WS-3. Change in Water Use in the CVPM Subbasins**
**(Change from No Action Alternative in thousands of acre-feet/year)**

| | Changes in Water Use for an Average Year that Follows a 5-year period that is: | | | | | |
|---|---|---|---|---|---|---|
| | Average | | Wet | | Dry | |
| CVPM Subbasins | Surface Water | Ground Water | Surface Water | Ground Water | Surface Water | Ground Water |
| 13 | 16.7 | -16.7 | 16.6 | -16.6 | -60.2 | 60.2 |
| 16 | -16.2 | 14.9 | -16.2 | 14.8 | -16.2 | 15.0 |
| 17 | 3.9 | -3.8 | 3.8 | -3.8 | 4.0 | -3.9 |
| 18 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | -0.1 |
| 20 | 0.1 | -0.1 | 0.1 | -0.1 | -0.2 | 0.1 |
| 21 | 0.0 | 0.0 | 0.0 | 0.0 | -0.1 | 0.1 |

| | Changes in Water Use for an Wet Year that Follows a 5-year period that is: | | | | | |
|---|---|---|---|---|---|---|
| | Average | | Wet | | Dry | |
| CVPM Subbasins | Surface Water | Ground Water | Surface Water | Ground Water | Surface Water | Ground Water |
| 13 | 33.2 | -36.2 | 33.1 | -36.1 | -113.1 | 109.1 |
| 16 | -15.7 | 13.2 | -15.7 | 13.2 | -15.7 | 13.2 |
| 17 | 7.4 | -7.4 | 7.3 | -7.2 | 7.4 | -7.4 |
| 18 | 0.0 | -4.0 | 0.0 | -4.0 | 0.1 | -3.8 |
| 20 | 0.1 | 0.0 | 0.1 | 0.0 | -0.1 | 0.0 |
| 21 | 0.0 | 0.0 | 0.1 | -0.1 | -0.1 | 0.0 |

| | Changes in Water Use for an Dry Year that Follows a 5-year period that is: | | | | | |
|---|---|---|---|---|---|---|
| | Average | | Wet | | Dry | |
| CVPM Subbasins | Surface Water | Ground Water | Surface Water | Ground Water | Surface Water | Ground Water |
| 13 | 0.0 | -3.8 | 0.0 | -3.8 | 0.0 | -3.8 |
| 16 | -12.9 | 11.5 | -12.9 | 11.5 | -12.9 | 11.5 |
| 17 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 |
| 18 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 |
| 20 | 0.0 | 0.0 | 0.0 | 0.0 | -0.1 | 0.0 |
| 21 | 0.0 | 0.0 | 0.0 | 0.0 | -0.1 | 0.0 |

Note:

A positive number represents an increase in the use of water and a negative number represents a decrease in water use from the NAA.

**Table WS-4**

**Irrigation Districts within CVPM Economic Subbasins**

| CVPM Subbasin | Friant Division Districts |
|---|---|
| 13 | Madera ID, Chowchilla ID, Gravely Ford. |
| 16 | Fresno ID, Garfield, International. |
| 17 | Orange Cove. |
| 18 | Lower Tule River ID, Delano-Earlimart, Exeter, Ivanhoe, Lewis Creek, Lindmore, Lindsay-Strathmore, Porterville, Saucelito, Stone Corral, Tea Pot Dome, Terra Bella, Tulare. |
| 20 | Shafter-Wasco, San Joaquin. |
| 21 | Arvin-Edison.Water Storage District |

In most of the combinations of years simulated in CVPM, there was little or no change in surface and ground water use relative to the NAA. Simulated changes that occurred reflected an equal shift from surface water to ground water or vice versa. For example, in subbasin 13 for average years, there is an increase in surface water use and a corresponding decrease in ground water use when the previous five years are average or wet. The pattern is reversed and less surface water is used when the previous five years are dry. In the neighboring subbasin 16, the water users shift to ground water. In an average year following an average five-year period, 16,700 af more surface water is used in subbasin 13 relative to the NAA, while in subbasin 16, 200 af less surface water is used. These CVPM simulations show that water users within a given subbasin will adjust surface water use from year-to-year under Alternative 2, but the net effect is to shift between surface and ground water. In addition, when users in one part of the Friant Division use less surface water for a given year, users in another portion of the Division will use more surface water. These effects reflect a redistribution of water supplies for one-year periods and not a long-term shift in water supply. Overall, the water supply is still available to the contractors and will be used in the Division. Water needs assessments show that there is an irrigation water shortfall in 2025. If individual districts choose not to purchase surface water and pump ground water because the tiered pricing, other districts with less access to ground water will purchase the unused surface water to meet the shortfall. The net effect will be to continue to fully use the water supply available to the Friant Division.

Flood control releases that have historically been made down the Friant-Kern and Madera Canals will continue. This alternative will not decrease that potential water supply because this water supply is not included in the Category 1 or 2 water.

## Cumulative Effects

Based on historical trends in surface water use south of the Delta and information presented in the CVPM simulations there are no projected impacts on water supply and thus no contribution to cumulative effects on water supply.

## GROUND WATER RESOURCES

### Affected Environment

The Friant Division lies within the San Joaquin River and Tulare Lake ground water hydrologic regions. The regions are further divided into ground water subbasins. Within the San Joaquin River Region, the Friant Unit is located in the Chowchilla and Madera subbasins. In the Tulare Lake Region, the Friant Unit is also located in the Kings, Kaweah, Tule, and northern portion of the Kern County basins.

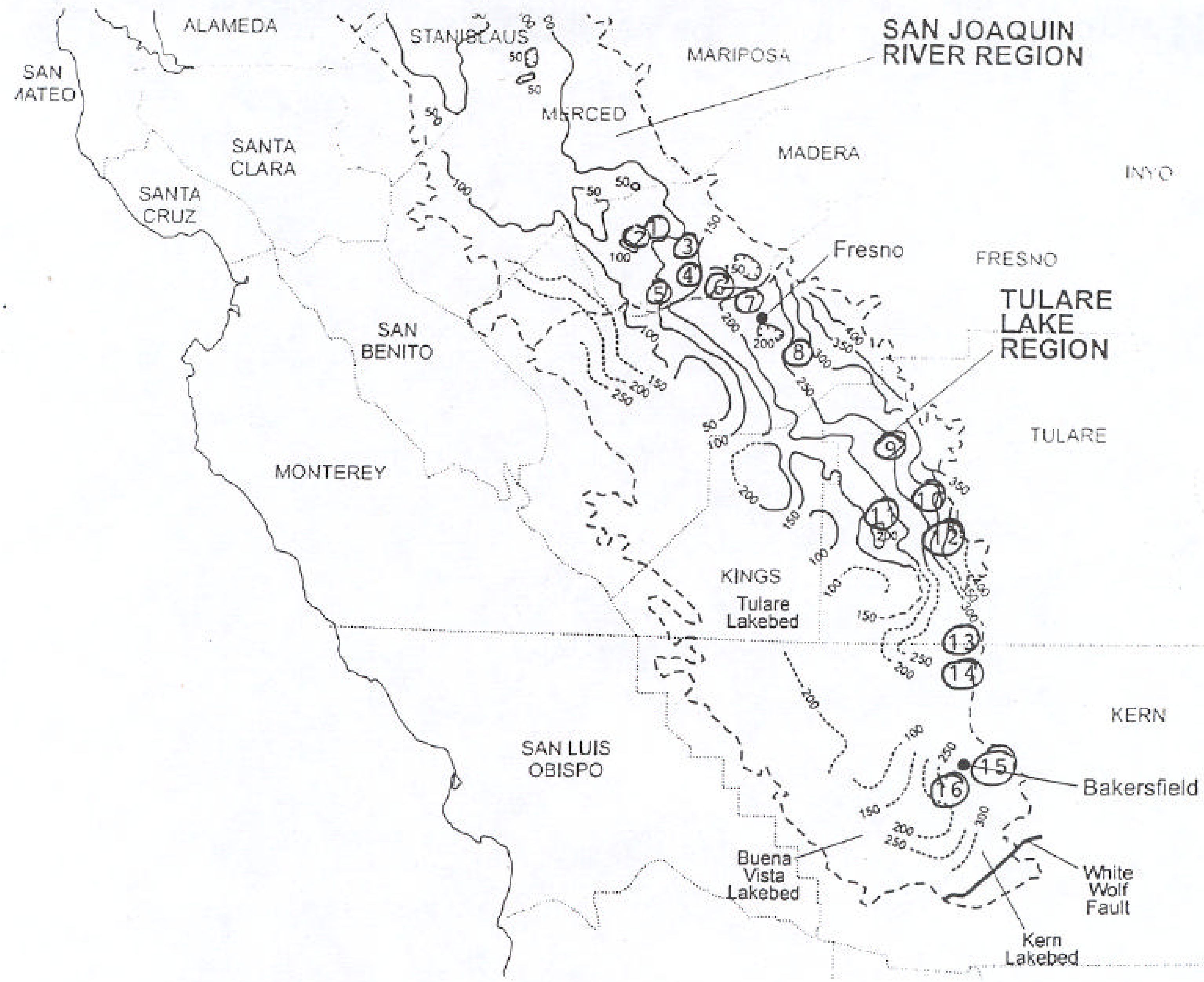
Recharge of the semiconfined aquifer in the Regions is primarily derived from seepage from streams and canals, infiltration of applied water, and subsurface inflow. Precipitation on the valley floor provides some recharge, but only in abnormally wet years. Seepage from streams and canals is highly variable depending on annual hydrologic conditions.

#### *Ground Water Storage and Production*

The usable storage capacity was estimated to be approximately 24 million af for San Joaquin River Region and 28 million af for the Tulare Lake Region. DWR estimated a level of ground water extraction that would not lower ground water levels over the long-term (perennial yield) to be approximately 3.3 million af for the San Joaquin River Region. The perennial yield is 4.6 million af for the Tulare Lake Region. This perennial yield is directly dependent upon the amount of recharge received by the ground water basin, which may be different in the future than it has been in the past.

Ground water storage in San Joaquin Valley reached a low point in 1978, as a result of the 1976 - 1977 drought period. By the early 1980s, ground water storage returned to predrought conditions. Ground water storage again declined during the 1987-1992 drought. At the end of the 1990 water year, ground water storage was similar to 1978 conditions. These area wide ground water storage fluctuations in the San Joaquin Valley basin are not uncommon.

Ground water pumping ranged from 1.6 million af in 1922 to 4.7 million af in 1977. Ground water pumping has been rising steadily through the 1970s, and has varied greatly from year to year depending on hydrologic conditions. The largest year-to-year fluctuation occurred during the 1976 - 1977 drought period. Immediately following the drought, hydrologic wet and above normal conditions for the years 1978 to 1980 resulted in reduced pumping. However, urban growth during the 1980s has contributed to an increase in ground water usage. In addition, increased ground water pumping in the late-1980s and early-1990s occurred as a result of reduced surface water deliveries to CVP water users due to the imposition of environmental requirements on the operation of surface water facilities, and critically dry hydrologic conditions during the 1987 to 1992 drought period. DWR estimated that recent ground water pumping (1990) in the San Joaquin River Region at 3.5 million af and Tulare Lake Region at 5.2 million af. This exceeds the estimated perennial yield in the San Joaquin River Region and 630,000 af in the Tulare Lake Region by approximately 200,000 af . All of the basins within the San Joaquin River and Tulare Lake Regions experienced some overdraft.




**NOTE: NUMBERS REFER TO APPROXIMATE LOCATION OF GROUND WATER WELL**

| LEGEND: | |
| --- | --- |
| 200 | Unconfined Groundwater Level Contour (ft msl) (contours dashed where inferred) |
| - - - - | Alluvial Boundary |

Source: Reclamation, 1999

N

**FIGURE GW-1**
**MONITORING WELLS IN THE SAN JOAQUIN VALLEY**

### *Ground Water Levels*

Expansion of agricultural practices between 1920 and 1950 caused declines in ground water levels in many areas of the San Joaquin River Region. Along the east side of the San Joaquin River Region declines have ranged between 40 and 80 feet since pre-1860 development conditions. Ground water levels declined substantially in the Madera County, which depends heavily on ground water for irrigation.

Ground water levels in the semiconfined aquifer between Spring 1970 and Spring 1980 declined in response to 1976-1977 drought conditions and recovered to near predrought levels by 1980. The 1987-1992 drought resulted in substantial deficiencies in surface water deliveries and corresponding increases in ground water pumping. Water levels declines of 20 to 30 feet are common throughout most of the central and eastern parts of the San Joaquin Valley. Depression areas resulting from ground water withdrawals are indicated along the east side of the San Joaquin River Region in Merced and Madera counties and are less than 50 feet above sea level. These ground water levels are indicative of depleted conditions due to regional ground water withdrawals resulting from the 1987-1992 drought period. This is consistent with observed storage recovery time, which may span several years. For example, recovery to predrought storage conditions took more than five years following the 1976-1977 drought.

During the 10-year period from Spring 1970 to Spring 1980, semi-confined ground water levels generally dropped in the Tulare Lake Region. In portions of Fresno, Kings, Kern, and Tulare counties, semi-confined ground water levels dropped as much as 50 feet since spring 1970. The semi-confined aquifer in the Tulare Lake Region showed little change between spring 1980 and spring 1988.

DWR collects and summarizes ground water data for thousands of wells across the San Joaquin Valley. These data show the historical trends in ground water elevation for the basins in the Friant Division and Cross Valley Canal Unit. The data are subdivided into several basins that are defined by geologic and hydrologic conditions. The subbasins and the associated water districts are shown in Table GW-1. Representative wells are shown in Figure GW-1.

**Table GW-1**
**Ground Water Subbasins and Water Service Areas in the Friant Division**

| **Ground Water Subbasin Water/Irrigation District** | |
|---|---|
| **Chowchilla Basin** | |
| Chowchilla Water District | |
| **Madera Basin** | |
| Fresno County Water Works #18 | Madera Irrigation District |
| Gravelly Ford Water District | Madera County |
| **Kings Basin** | |
| Fresno City | International Water District. |
| Fresno Irrigation District | Orange Cove, City of |
| Garfield Water District | Orange Cove Irrigation District |
| **Kaweah Basin** | |
| Exeter Irrigation District | Lindsay-Strathmore Irrigation District |
| Ivanhoe Irrigation District | Stone Corral Irrigation District |

**Table GW-1**
**Ground Water Subbasins and Water Service Areas in the Friant Division**

| Ground Water Subbasin Water/Irrigation District | |
|---|---|
| Lewis Creek Water District | Tulare County |
| Lindmore Irrigation District | Tulare Irrigation District |
| Lindsay, City of | |
| **Tule Basin** | |
| Delano-Earlimart Irrigation District | So. San Joaquin Municipal Utility District |
| Lower Tule River Irrigation District | Tea Pot Dome Water District |
| Porterville Irrigation District | Terra Bella Irrigation District |
| Saucelito Irrigation District | |
| **Kern County** | |
| Arvin-Edison Water Storage District | Shafter-Wasco Irrigation District |

*Chowchilla Basin*

The Chowchilla Basin includes the Chowchilla Water District and the City of Chowchilla. It receives inflow from the Chowchilla River. The historic ground water data in the Chowchilla Basin shows ground water conditions were increasing in the 1970's in response to the available surface water supply (Figure GW-2). The water table decreased during the drought of 1989-1994. Since the drought, the water table has recovered slightly but not completely.

*Madera Basin*

The Madera Basin includes the area around the City of Madera and is supplied by the Fresno River. The water table declined during the drought period of the early 1990's and has not recovered (Figure GW-3).

*Kings Basin*

The Kings Basin includes the area around Fresno, extending to the foothills. The water supply for this basin is the Kings and San Joaquin Rivers. The basin declined following the drought in the early 1990's and has not yet recovered (Figure GW-4). The portion of the basin near Orange Cove declined during the drought but has recovered to pre-drought conditions.

*Kaweah Basin*

The Kaweah Basin encompasses the area around the City of Visalia and is supplied from the Kaweah River. Ground water levels decline of over 20 feet during the drought but have recovered somewhat (Figure GW-5). North of Visalia, ground water levels have not completely recovered.

*Tule Basin*

The Tule Basin includes the area from Porterville to Delano and is supplied from the Tule River. Ground water levels in the Tule Basin declined during the drought but have recovered somewhat (Figure GW-6).

Near Delano however, the ground water elevation remains about 20 feet lower than the pre-drought conditions.

*Kern County*

The Kern County Basin includes the area south of Bakersfield and is supplied from the Kern River (Figure GW-7). The basin declined steadily until the mid 1970’s when it began to recover. The basin declined in the early 1990’s in response to drought conditions but has begun to recover.

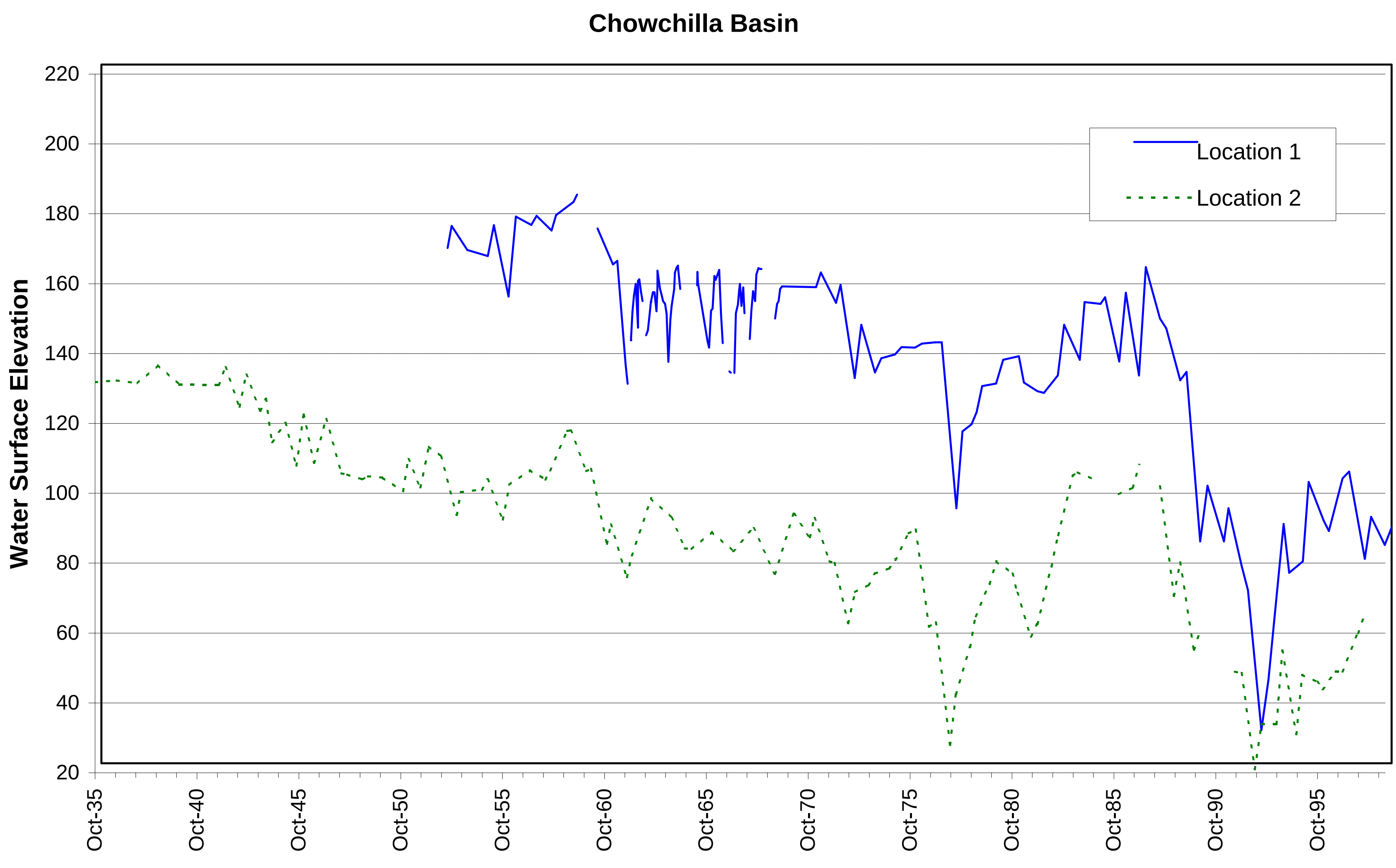



Figure GW-2
Ground Water Conditions in the Chowchilla Subbasin

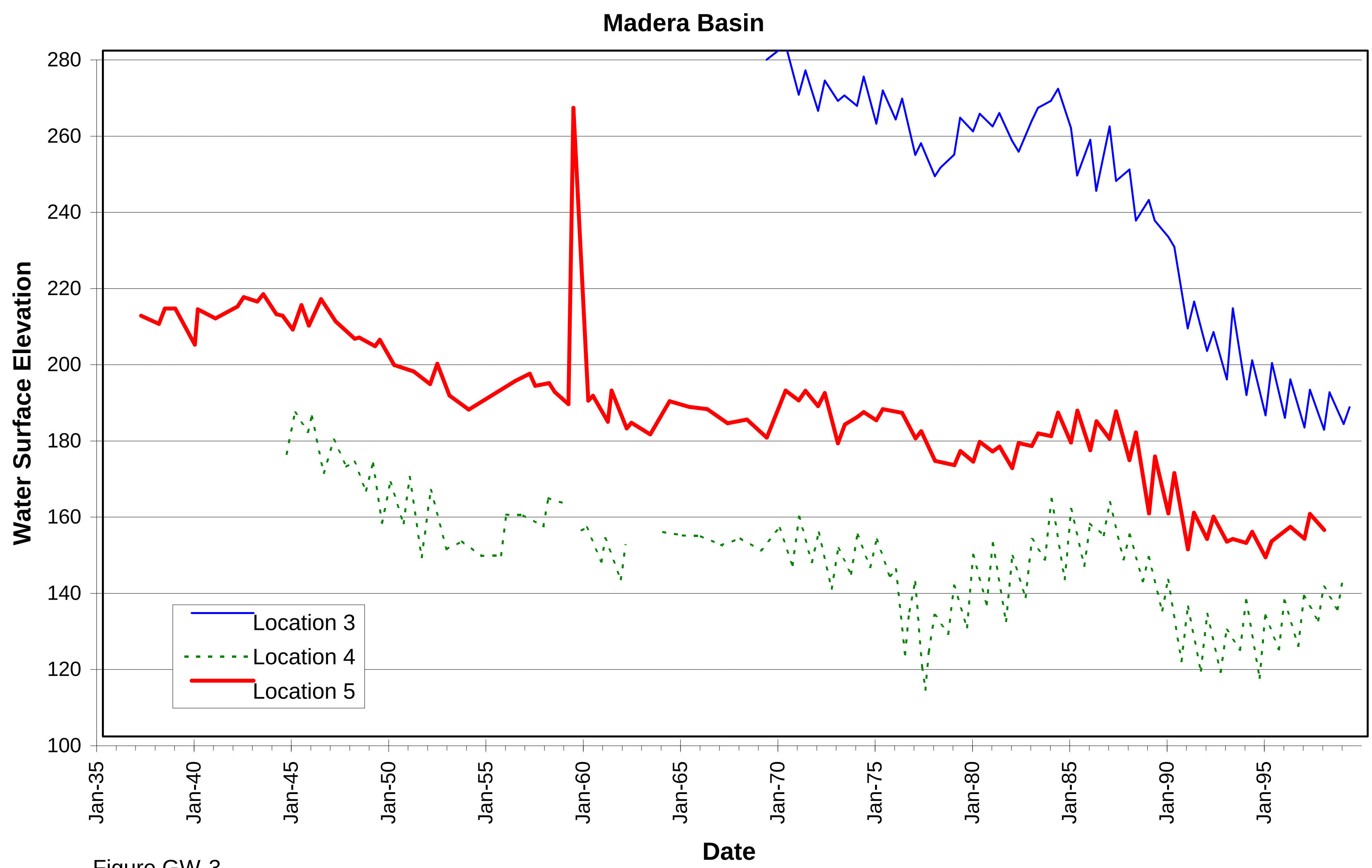



Figure GW-3
Ground Water Conditions in the Madera Subbasin

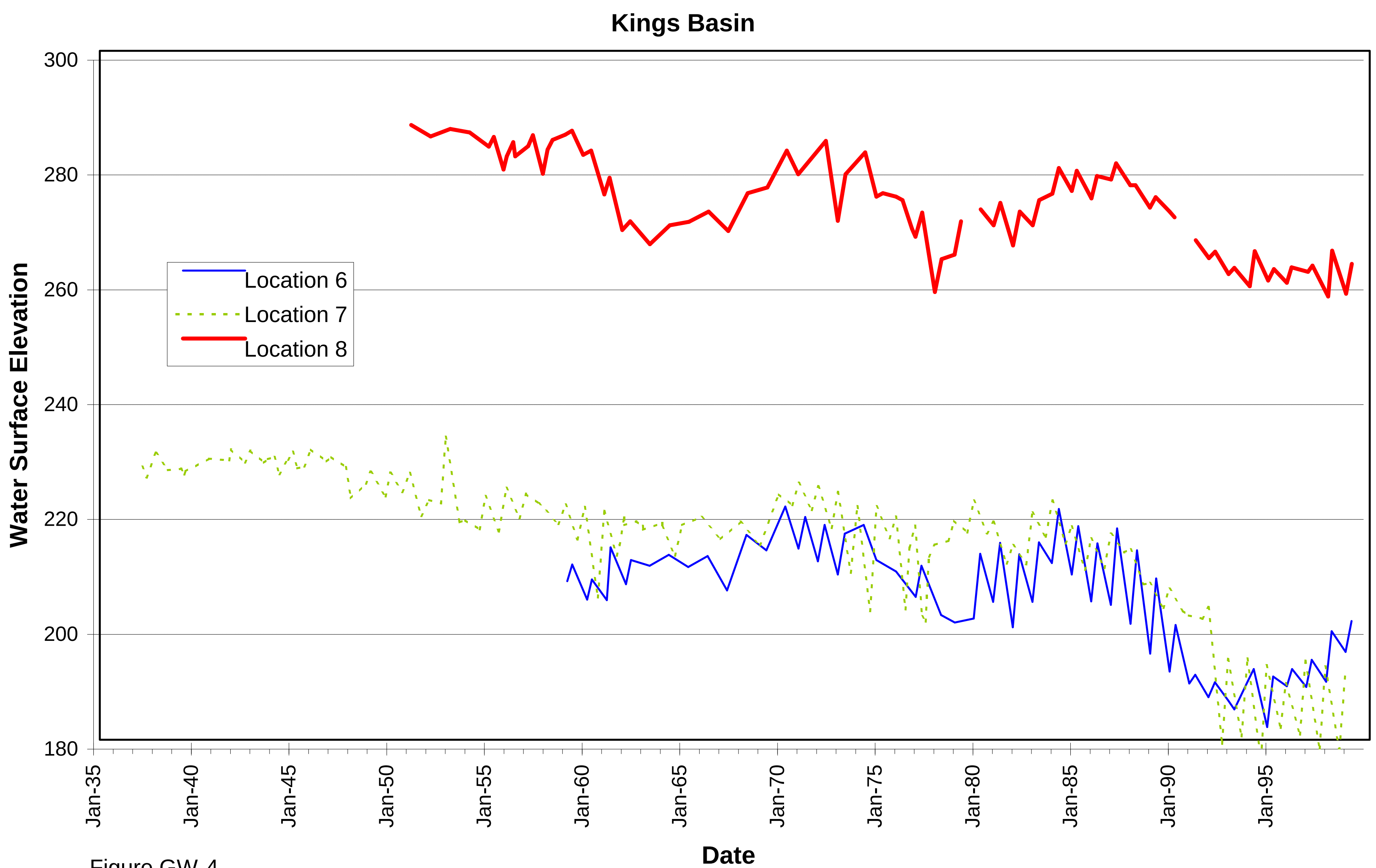



Figure GW-4
Ground Water Conditions in the Kings Subbasin

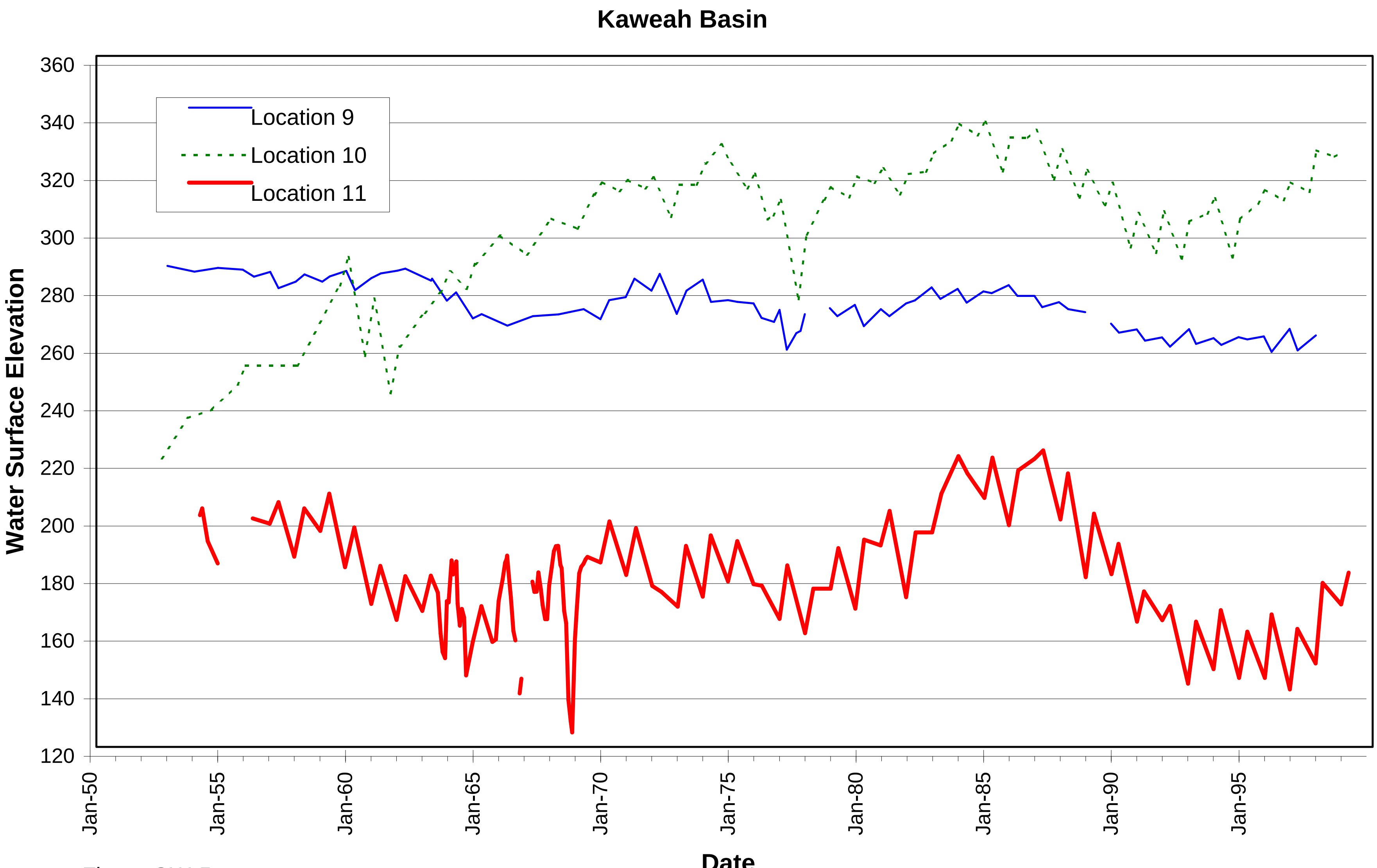



Figure GW-5
Ground Water Conditions in the Kaweah Subbasin

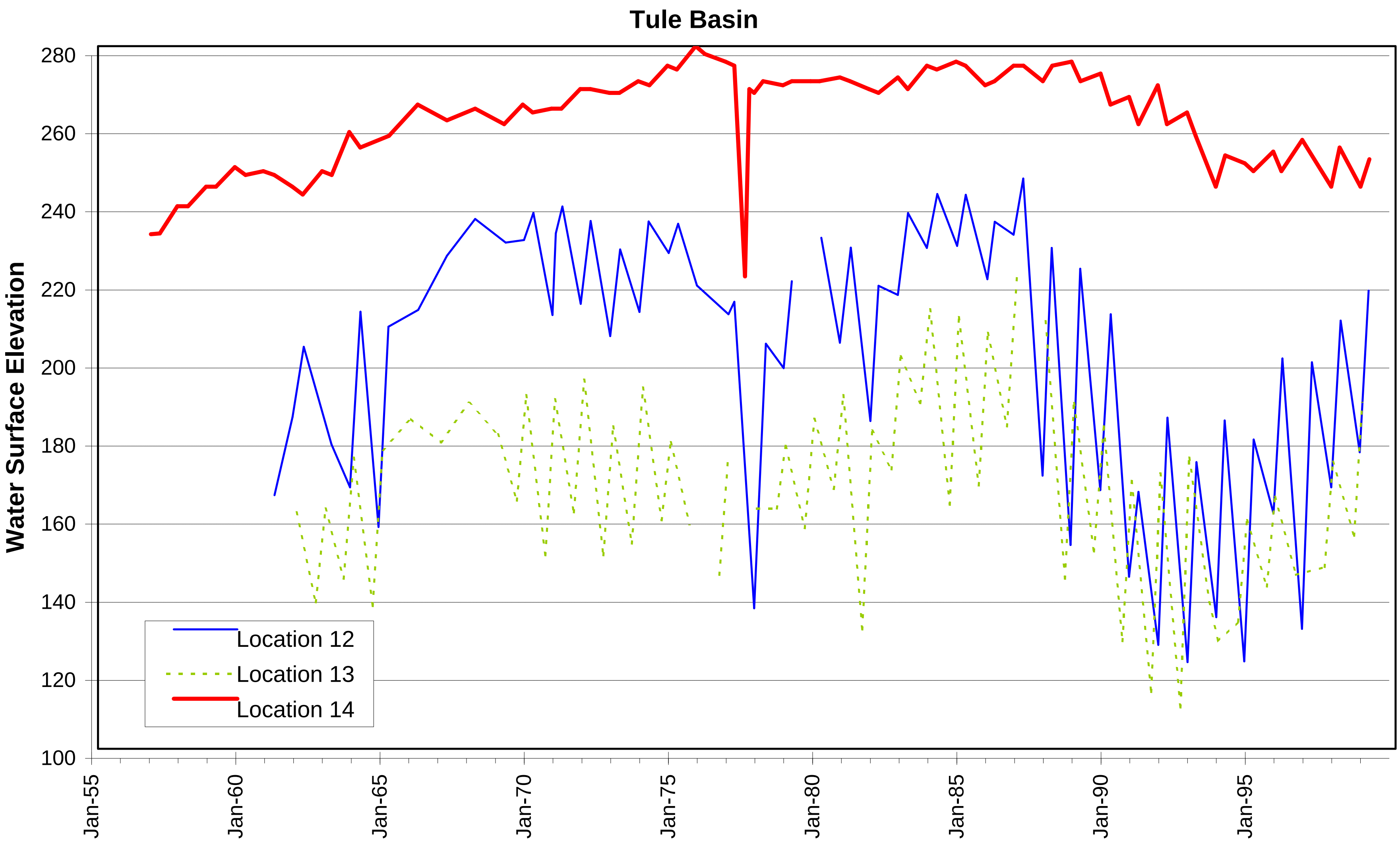



Figure GW-6
Ground Water Conditions in the Tule Subbasin

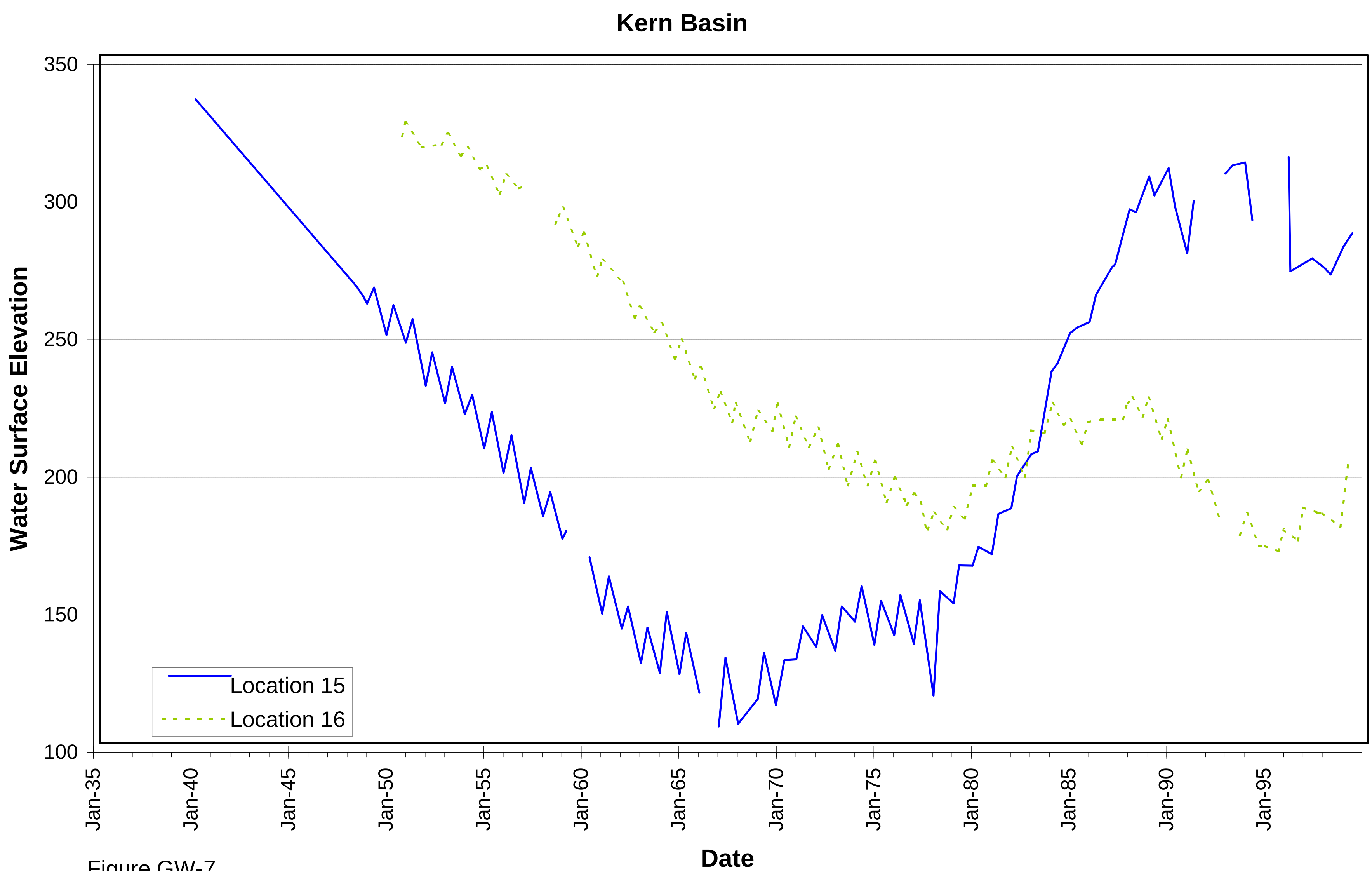



Figure GW-7
Ground Water Conditions in the Kern Subbasin

## Environmental Consequences

Under most conditions, many Contractors will supplement CVP water by pumping and applying ground water. Even during times of normal surface water availability, a number of areas within the service area require supplemental ground water to meet their irrigation needs. While the general trend for the past 50 years throughout the region has been one of declining ground water elevations, many of the major ground water aquifers in the area experienced dramatic drawdown during the late-1980s and early-1990s. While most of these aquifers have recovered to near pre-drawdown levels, the recovery rates have been widely variable. Furthermore, data from monitoring wells indicate that recovery from the late-1980s early-1990s drawdown has not occurred in some areas. In these areas, ground water elevations remain near the historic low levels reached during the drawdown.

As discussed below, both the volume pumped and the overall requirement for supplemental ground water are anticipated to vary on both regional and sub-regional (local) basis throughout the basin. Overall, however, it is assumed that localized increases in ground water pumping in a certain year type will be offset by increased use of CVP water and reduced pumping in other years.

### *No Action Alternative*

The ground water conditions for the southern San Joaquin Valley under the NAA are described in the PEIS. During dry periods, groundwater use would increase in response to decreased surface water supplies. It is assumed that the Contractors will return to greater use of surface water at the conclusion of the dry period. This should allow the ground water table to recharge.

### *Alternative 1*

It is assumed that the environmental effects of the alternative will be similar to the NAA. The potential environmental consequences therefore will not differ significantly from those associated with the NAA.

### *Alternative 2*

The effects of the tiered pricing proposal of Alternative 2 on the water supply in the Friant Division was simulated with the CVPM model (Table GW-2). Under Alternative 2, ground water use relative to the NAA varies depending on the year and the previous five years. The largest change in ground water use is simulated for subbasin 13 in a wet year following a five-year dry period. The change in ground water use was simulated to be 109,100 af (out of a total use of 812,000 af) spread across subbasin 13. A single wet year following the five dry years occurred in 1993, but in general is an uncommon occurrence.

**Table GW-2**
**Change in Ground Water Use in the CVPM Subbasins**
**(Change from NAA in thousands of acre-feet/year)**

| CVPM Subbasins | Change in Ground water Use for an Average Year that Follows a 5-year period that is: Average | Wet | Dry |
|---|---|---|---|
| 13 | -16.7 | -16.6 | 60.2 |
| 16 | 14.9 | 14.8 | 15.0 |
| 17 | -3.8 | -3.8 | -3.9 |
| 18 | 0.0 | 0.0 | -0.1 |
| 20 | -0.1 | -0.1 | 0.1 |
| 21 | 0.0 | 0.0 | 0.1 |

| CVPM Subregions | Change in Ground water Use for an Wet Year that Follows a 5-year period that is: Average | Wet | Dry |
|---|---|---|---|
| 13 | -36.2 | -36.1 | 109.1 |
| 16 | 13.2 | 13.2 | 13.2 |
| 17 | -7.4 | -7.2 | -7.4 |
| 18 | -4.0 | -4.0 | -3.8 |
| 20 | 0.0 | 0.0 | 0.0 |
| 21 | 0.0 | -0.1 | 0.0 |

| CVPM Subregions | Change in Ground water Use for an Dry Year that Follows a 5-year period that is: Average | Wet | Dry |
|---|---|---|---|
| 13 | -3.8 | -3.8 | -3.8 |
| 16 | 11.5 | 11.5 | 11.5 |
| 17 | 0.0 | 0.0 | 0.0 |
| 18 | 0.0 | 0.0 | 0.0 |
| 20 | 0.0 | 0.0 | 0.0 |
| 21 | 0.0 | 0.0 | 0.0 |

Note:
A positive number represents an increase in the use of water and a negative number represents a decrease in water use from the NAA.

In most areas, a single year of substantially increased ground water pumping is unlikely to critically affect ground water elevations. Rather, as was observed during drought periods in the 1970s, 1980s and 1990s, the greatest decreases in ground water elevations occurred during periods of multiple-year below-average surface water availability. During such drought cycles it is likely that ground water aquifers throughout the Friant Division service area will experience drawdown. The CVPM analysis demonstrates that in other year types, such as a wet year following a five-year average period, the ground water pumping decreases. This would offset the years of increased ground water pumping. The long-term effects of increases and decreases in ground water pumping are unknown at this time because water users may respond differently than predicted in the model.

### Cumulative Effects

A number of ongoing and planned activities related to surface water in the San Joaquin Valley may place additional demands on CVP water resources. Specifically, plans to restore riparian habitat, anadromous fish habitat (the Anadromous Fish Restoration Program or AFRP) would require additional water supplies. These water demands will increase the competition for the available surface water supplies and force additional reliance on ground water resources. Implementation of Alternatives 1 or 2, however, will not influence the cumulative effects of those other actions.

The recent deregulation of the power industry may lead to increased costs for electricity. This would tend to make ground water more expensive and offset the simulated increases in pumping in certain years.

## WATER QUALITY

### Affected Environment

The following describes the affected environment for water quality within the Friant Division and associated waterways. The affected water quality in the San Joaquin River and Tulare Lake basins considers surface water quality and ground water quality.

#### *Surface Water Quality*

Surface water quality in the San Joaquin River Basin is affected by several factors, including natural runoff, agricultural return flows, biostimulation, construction, logging, grazing, operations of flow regulating facilities, urbanization, and recreation. The upper reaches of the rivers draining to the San Joaquin River Basin originate in large drainage areas high on the western side of the Sierra Nevada. The water in these rivers is generally soft with low mineral concentrations. As these streams flow from the Sierra Nevada foothills across the eastern valley floor, their mineral concentration steadily increases. This increase in concentration is fairly uniform for each of the east side streams.

Above Millerton Lake and downstream towards Mendota Pool, water quality is generally excellent. The reach from Gravelly Ford to Mendota Pool (about 17 miles) is frequently dry except during flood control releases because all water released from Millerton Lake is diverted upstream to satisfy water rights agreements, or percolates to ground water.

Wildlife refuges and duck clubs also contribute water of degraded quality to the San Joaquin River. The refuges begin flooding operations in the fall to maintain habitat for migratory waterfowl, primarily with water delivered from the Delta via the Delta-Mendota Canal. The salinity of the water in the ponds may increase during the fall due to evaporation and following winter seasons with low precipitation, often contributing poor quality water to the San Joaquin River when the ponds are drained in the spring.

The COE annually reviews the water quality of Eastman Lake and Hensley Lake. The survey of Eastman Lake indicates thermal stratification in the summer with some dissolved oxygen depletion in the bottom waters of the lake. The studies also found that excessive nutrient levels that could lead to algae blooms

blooms were not present. Mercury and MTBE were the only constituents of concern in the study. Mercury levels in August 1999 were measured at 0.050 Fg/L at the lake bottom. This level exceeds the EPA standard of 0.012 Fg/L and future studies will analyze fish tissue to determine the fate of the mercury (COE, 2000a). The survey of Hensley Lake found similar thermal stratification on low nutrient levels. The only constituents of concern were mercury and cadmium. Mercury was measured at lake bottom at 0.080 Fg/L, which exceeds the 0.012 Fg/L EPA criteria. The cadmium level was 2 Fg/L at the lake bottom, which exceeds the 0.55 Fg/L EPA criteria. Future monitoring will include fish tissue surplus (COE 2000a).

The survey of Hensley Lake found similar thermal stratification on low nutrient levels. The only constituents of concern were mercury and cadmium. Mercury was measured at lake bottom at 0.080 Fg/L which exceeds the 0.012 Fg/L EPA criteria. The cadmium level was 2 Fg/L at the lake bottom, which exceeds the 0.55 Fg/L EPA criteria. Future monitoring will include fish tissue surplus (COE 2000b).

***Ground Water Quality***

Ground water quality conditions in the San Joaquin River Region and the Tulare Lake Region vary throughout the area. A description of specific water quality parameters is provided below.

**Total Dissolved Solids (TDS).** TDS concentrations vary considerably in the San Joaquin River Region, depending upon the ground water zone. Characteristics of TDS in the Tulare Lake Region are similar to those occurring in the San Joaquin River Region but higher than the east of the San Joaquin Valley. This distribution reflects the low concentrations of dissolved solids in recharge water that originates in the Sierra Nevada, and the predominant regional ground water flow pattern. Typically, on the east side, TDS concentrations generally do not exceed 500 mg/L.

**Boron.** High boron concentrations occur in the northwestern part of the San Joaquin River Region from the northernmost edge of the region to the southernmost edge of the region. In the southern portion of the Tulare Lake Region, high concentrations of boron are generally found in areas southwest to Bakersfield (greater than 3 mg/L) and southeast of Bakersfield (1 to 4 mg/L). However, boron in ground water in the Friant Division area is not identified as a concern.

**Nitrates-Nitrate.** Several small areas of the Tulare Lake Region contain nitrates-nitrate concentrations in excess of 10 mg/L. These include areas south and north of Bakersfield, around the Fresno metropolitan area, and scattered areas of the Sierra Nevada foothills in the Hanford-Visalia area. Municipal use of ground water as a drinking water supply is also impaired due to elevated nitrate concentrations in the Madera area and throughout the Tulare Lake Region.

**Arsenic.** In the Tulare Lake Region agricultural use of ground water is impaired due to elevated arsenic concentrations in the Tulare Lake Region, particularly in areas of the Kern Basin near Bakersfield. Ground water in the Friant Division area is not identified as a concern for elevated concentrations of arsenic.

**Dibromochloropropane (DBCP).** DBCP has been detected in many ground water wells in the San Joaquin River Region and the Tulare Lake Region. Municipal use of ground water as drinking water supply is impaired due to elevated DBCP concentrations near several cities including Chowchilla, Madera, Merced, Visalia, Bakersfield, Fresno area, and scattered locations in southwest Tulare County.

## Environmental Consequences

Water quality in the Friant Division could be adversely affected during protracted dry conditions. During these times it is expected that many contractors may increase their pumping and use of ground water. This response is consistent with the conjunctive use design of the Friant Division. Protracted and preferential usage of ground water to irrigate crops may lead to localized increases in ground water salt concentrations. Increased ground water salinity poses a problem for contractors because its long-term, frequent use can significantly reduce soil quality and utility. The tendency to misread soil salinity can be offset by alternating groundwater irrigation with applications of low salinity surface water from Millerton Lake.

### *No Action Alternative*

Water quality in the rivers and ground water of the Friant Division under the NAA is not anticipated to change from past conditions. Factors that tend to influence water quality, such as agricultural runoff, will continue similar to historic conditions. Because ground water quality is influenced by factors such as deep percolation of applied water, a shift in the quality of applied water may change ground water quality.

### *Alternative 1*

Alternative 1 is assumed to have similar effects on ground water as the NAA. Therefore, there are no environmental effects resulting from implementation of this alternative.

### *Alternative 2*

The Ground Water section of this EA described the potential impacts associated with increases in ground water pumping in subbasin 13 during a wet year that follows a dry five-year period. It is unknown if other years with decreased ground water pumping would offset this increase over the long term.

Increased use of ground water might affect the dissolved solids content in agricultural drainage percolation to the water table. Although the short-term effects of such changes in water quality are likely limited, extended and extensive reliance on ground water will possibly lead to increases in the salinity of applied water and in the ground water basin.

Ground water pumping is projected to increase for certain years in response to the availability and price of surface water. Depending on the geographic areas where the pumping would increase, the quality of the water used for irrigation may be less than the quality of the surface water available under the NAA.

### Cumulative Impacts

The water demands associated with the foreseeable projects will increase the demand for the limited water resources of the area. However, projects that supply additional water to the San Joaquin River as part of restoration efforts will tend to improve water quality. Implementation of Alternatives 1 or 2 will not influence the cumulative effects of these other actions on water quality.

## FISHERIES RESOURCES

### Affected Environment

The fisheries resources affected by the Friant Division inhabit reservoirs and streams. The principal stream affected by the Division is the San Joaquin River downstream of Friant Dam. The fish found in Division waters include both native and introduced fish species based on records of the California Department of Fish and Game and other sources (Table FR-1). The status of fish species in terms of the Federal Endangered Species Act (ESA) and special status for the State of California also is identified in Table FR-1. Chinook salmon and steelhead trout that migrate through the San Joaquin River to and from its tributaries are both listed under the ESA.

***<u>Anadromous Fish Restoration Program (AFRP)</u>***

CVPIA Section 3406(b)(1) states, "The Secretary...is authorized and directed to...develop within three years of enactment and implement a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967- 1991..." The section also states, "this goal shall not apply to the San Joaquin River between Friant Dam and the Mendota Pool."

The Service and Reclamation approached implementing the directive to "at least double natural production of anadromous fish" by developing the AFRP. The AFRP is the cornerstone of many actions aimed at restoring natural production of anadromous fish in the Central Valley and includes partnerships, local involvement, public support, adaptive management, and flexibility.

To plan and implement a comprehensive program, the AFRP requires ongoing, intensive public involvement at two levels. The first level is programmatic, involving efforts to plan a comprehensive program. The second level is action-specific and involved implementing specific actions in individual watersheds. At the action-specific level, the AFRP worked with local agencies and local watershed workgroups.

After public review and revision, Interior released a Revised Draft Restoration Plan for the AFRP in June 1997. The Restoration Plan presented the overall goal, objectives, and strategies of the AFRP and described how the AFRP identified and prioritized nearly 300 restoration actions and evaluations. The Restoration Plan is a programmatic-level description of the AFRP, and is used to guide implementation of all CVPIA sections. In the future, a detailed implementation plan will be completed. This plan will be an evolving document, amended over time as additional information is gathered, partnerships are formed, and actions are implemented. Water for this activity will come from willing sellers. No new water will be allocated from the CVP.

***Fish Species or Communities Included***

Reservoir fish communities in the Division, particularly that of Millerton Lake, consist of a combination of centrarchid and other species of recreational importance as well as native fish and introduced forage fish. The fish of recreational importance are largely introduced species or native fish such as rainbow trout of hatchery origin.

Fish in the mainstream of the San Joaquin River downstream of Friant Dam include native and non-native resident species as well as anadromous fish. As identified above, two of the anadromous salmonid species that migrate through the San Joaquin River are listed under the ESA.

To characterize the life histories and habitat use of the fish found in the Division's waters, target species were selected to represent the fish community. The target species for the reservoirs include species of recreational and economic importance that may be particularly sensitive to changes in reservoir water levels. Species selected for reservoir fishes are largemouth bass, smallmouth bass, crappie, sunfish, striped bass, and American shad. The target species for the San Joaquin River downstream of Friant Dam include ESA-listed salmonids, recreational species, and native minnows. Chinook salmon, steelhead trout, Sacramento pikeminnow, and largemouth bass were selected to represent the requirements of fishes in the mainstream San Joaquin River.

**Table FR-1**
**Fish Species of Waters Associated with the Friant Division**

| Species | San Joaquin River (below Friant Dam) | Millerton Reservoir | Fine Gold Creek (trib. to Millerton Lake) | Hensley Reservoir | Chowchilla River | Eastman Reservoir |
|---|---|---|---|---|---|---|
| Lamprey<br>*Lampetra spp.* | N | | | | | |
| White sturgeon<br>*Acipenser transmontanus* | N | N | | | | |
| American shad<br>*Alosa sapidissina* | I | I | | | | |
| Threadfin shad<br>*Dorosoma petenense* | I | I | | | | |
| Chinook salmon<br>*Oncorhynchus tshawytscha* | N, FPT | | | | | |
| Kokanee<br>*Oncorhynchus nerka* | | I | | | | |
| Brook trout<br>*Salvelinus fontinalis* | I | | | | | |

**Table FR-1**
**Fish Species of Waters Associated with the Friant Division**

| Species | San Joaquin River (below Friant Dam) | Millerton Reservoir | Fine Gold Creek (trib. to Millerton Lake) | Hensley Reservoir | Chowchilla River | Eastman Reservoir |
|---|---|---|---|---|---|---|
| Rainbow trout (includes resident fish only) *Oncorhynchus mykiss* | N | N | | N | N | N |
| Steelhead trout *Oncorhynchus mykiss* | N, FT | | | | | |
| Carp *Cyprinus carpio* | I | I | | | | I |
| Goldfish *Carassius auratus* | I | I | | | I | |
| Golden shiner *Notemigonus crysoleucas* | I | I | | I | I | I |
| Blackfish *Orthodon microlepidotus* | N | N | | | | |
| Hardhead *Mylopharodon conocephalus* | N, SC | N, SC | | N, SC | N, SC | N, SC |
| Hitch *Lavinia exilicauda* | N | | | | N | |
| Sacramento pikeminnow *Ptychocheilus grandis* | N | N | | N | N | N |
| Sacramento sucker *Catostomus occidentalis* | N | N | N | | N | N |
| Channel catfish *Ictalurus punctatus* | I | I | | I | I | I |
| White catfish *Ictalurus catus* | I | I | | I | I | I |
| Brown bullhead *Ictalurus nebulosus* | I | I | | I | I | I |
| Mosquitofish *Gambusia affinis* | I | I | | | I | |
| Inland siverside *Menidia audens* | | I | | | | |
| Threespine Stickleback *Gasterosteus aculeatus* | N | | | | | |
| Striped bass *Morone saxatilis* | | I | | | | |
| Black crappie *Pomoxis nigromaculatus* | I | I | | I | I | I |
| White crappie *Pomoxis annularis* | I | I | | I | I | I |

**Table FR-1**
**Fish Species of Waters Associated with the Friant Division**

| Species | San Joaquin River (below Friant Dam) | Millerton Reservoir | Fine Gold Creek (trib. to Millerton Lake) | Hensley Reservoir | Chowchilla River | Eastman Reservoir |
|---|---|---|---|---|---|---|
| Warmouth *Lepomis gulosis* | I | | | | I | |
| Green sunfish *Lepomis cyanellus* | I | I | | I | I | I |
| Bluegill *Lepomis macrochirus* | I | I | | I | I | I |
| Redear sunfish *Lepomis microlophus* | I | I | | I | I | I |
| Largemouth bass *Micropterus salmoides* | I | I | | I | I | I |
| Spotted bass *Micropterus punctulatus* | | I | | I | | I |
| Smallmouth bass *Micropterus dolomieu* | I | I | | | | |
| Sculpin *Cottus* spp. | N | N | | | | |

Note:

| | | | |
|---|---|---|---|
| N | Native | SC | State listed as Special Concern |
| I | Introduced | FE | Federally listed Endangered |
| SE | State listed as Endangered | FT | Federally listed Threatened |
| ST | State listed as Threatened | FPE | Federally Proposed Endangered |
| SCE | State Candidate Endangered | FPT | Federally Proposed Threatened |
| SCT | State Candidate Threatened | | |

***Life History of Reservoir Fishes***

Life histories, distribution, and feeding preferences of recreational species in Central Valley reservoirs have been summarized (Moyle 1976).

*Largemouth Bass*

Largemouth bass were first introduced into California in 1874 and have since spread to most suitable waters. They are abundant in reservoirs and are normally found in warm, quiet waters with low turbidity and beds of aquatic plants. Largemouth bass provide an important sport fishery component of the Central Valley reservoirs and are one of the most sought after warm-water game fish in California.

Largemouth bass spawn for the first time during their second or third spring. Spawning activity usually begins in April, when water temperature reaches 61°F, but may continue through June. Males build nests in sand, gravel, or debris-littered bottoms at a depth of 3 to 6 feet. Rising reservoir levels could submerge active nests up to 15 feet during spring. Conversely, receding water levels can strand nests and expose them to desiccation. The eggs adhere to the substrate and hatch in two to five days. The sac fry usually spend five to eight days in or around the nest.

For the first month or two, fry remain in the shallows and feed mainly on rotifers and small crustaceans. By the time they are 2 to 3 inches long, they feed primarily on aquatic insects and fish fry. After reaching a length of 4 inches, largemouth bass feed primarily on fish and large aquatic invertebrates. Juvenile bass smaller than 4 inches rely on cover in shallow water to escape predation. Optimal temperatures for growth are 68 to 86°F. Bass may grow to 15-inches by the fourth or fifth year.

Food availability for largemouth bass may be affected by competition and by the amount of cover available to prey. Competition effects are likely to be most severe for young-of-the-year bass because they feed on zooplankton and other small invertebrates favored by many other fishes. In reservoirs such as Millerton Lake, competition with threadfin shad can depress the growth and survival of young bass, by reducing invertebrate populations used as food.

The overall quality of bass fishing in California reservoirs has declined since the reservoirs were constructed due to three main factors:

- over fishing,
- reservoir aging, and
- competition from threadfin shad and other plankton-feeding fishes (Von Geldern, 1974).

Largemouth bass are extremely vulnerable to angling, and at least half the population of legal-size fish is caught annually in many reservoirs. Over time, the catch rate declines and the fish caught are smaller on the average. Reservoir aging reduces cover and forage fish, which reduces largemouth bass populations. Competition between young bass and other plankton feeding fish, primarily threadfin shad, also reduces largemouth bass populations.

*Smallmouth Bass*

Smallmouth bass were first introduced into California in 1874 and since that time have become widespread. They have become established in large, two-story reservoirs and are normally found in cool waters, often near the upstream end of the impoundments. Compared to largemouth bass, smallmouth bass are of less importance as a sport fish. Their populations are scattered and mostly small, but the populations in the upper reaches of Millerton Lake can provide excellent opportunities to catch large, fast-growing fish.

Smallmouth bass spawn for the first time during their third or fourth year. Spawning activity usually begins in April, when water temperature reaches 55 to 61°F. Males build nests in rocky bottoms at a depth of 3 feet in reservoirs or in the lower portions of tributary streams of the larger rivers. The male guards the nest until the eggs hatch in 3 to 10 days. The sac fry usually spend 3 to 4 days in the nest.

The male herds and guards the fry for an additional one to three weeks; then they disperse into shallow water. Water level recession during this time can strand fry and desiccate nests or expose the fry to predation if shallow water and cover is eliminated.

For the first month or two, fry feed mainly on rotifers and small crustaceans. By the time they are 2 to 3 inches long, they feed primarily on aquatic insects and fish fry. Once smallmouth bass exceed 4 inches, they feed primarily on fish and large invertebrates. Growth in Central Valley reservoirs is excellent, so four-year-old fish are typically approximately 15 inches long and larger fish are not uncommon (Emig 1966). Optimum temperatures for growth and survival are approximately 68 to 81°F.

*Crappie*

Both black and white crappie have been abundant in Central Valley reservoirs since their successful introductions into the state in 1917 and 1908, respectively. The white crappie is more tolerant of turbidity, high temperatures, and lack of cover than the black crappie and may be displacing black crappie in some areas. Crappie are an abundant and popular game fish in many reservoirs. They provide particularly good fishing in spring and early summer. (Moyle 1976.)

Crappie tend to be found in highly localized schools that spend their days around large, submerged objects and their evenings and early mornings foraging in open water. Crappie become sexually mature in their second or third year. Spawning begins in March or April as temperatures exceed 57 to 63 °F and could continue through July. Males build nests in water less than 3 feet deep in or near beds of aquatic plants. The male guards the newly hatched fry for a few days. Should reservoir water levels recede beyond this spawning shelf during this time, nests and fry would be vulnerable to stranding and desiccation.

Crappie are opportunistic, mid-water feeders. Zooplankton and small insect larvae are the primary food sources for small fish. Adult crappie mainly eat fish. Optimum temperatures are in the range of 63 to 81°F (Edwards 1982a; 1982b).

*Sunfish*

Sunfish are represented by species of the genus *Lepomi*s. These include bluegill, redear sunfish, green sunfish, and warmouth. Sunfish were introduced into California in the late 1800s and early 1900s and are now found in every Central Valley reservoir. They maintain popular sport fisheries, and fishing usually has little effect on their populations because of their high reproductive rates.

Bluegill is the most widespread and abundant sunfish found in the reservoirs. This species has the ability to survive and reproduce under a wide variety of conditions. Bluegill often become too abundant in some reservoirs and intraspecific competition limits individual growth rates, resulting in a large population of stunted fish. Such large populations can limit populations of other game fishes by eating the eggs and young and competing for food that other young game fish need to survive.

Redear sunfish are not as fecund as bluegill and rarely have stunted populations in California. They are harder to catch than bluegill, live in deeper water, and are generally under exploited in California. Green sunfish are usually abundant only in areas of reservoirs with shallow, weedy areas that exclude most other species. Warmouth are relatively uncommon and are not a dominant sunfish in reservoirs.

In general, sunfish spawn in the spring when water temperatures reach 64 to 70°F. Sunfish can reach sexual maturity as early as one year old, but more frequently at two or three years of age. Males build nests in sand, gravel, or debris-littered bottoms and guard the nest until the eggs hatch in two to three days. The fry then disperse into aquatic plant beds in shallow water. If reservoir levels were drawn down beyond these shallow habitats, fry could be stranded and nests desiccated from exposure. Bluegill spend most of their lives in a rather restricted area, even in the large reservoirs. They are often associated with rooted aquatic vegetation and are rarely found deeper than 15 feet.

Sunfish are generally highly opportunistic feeders, taking whatever animal food is abundant in their shallow-water habitat. They typically feed on aquatic invertebrates, planktonic crustaceans, terrestrial insects, snails, small fish, fish eggs, and crayfish. Sunfish will also eat aquatic plants and algae when other food is scarce. Goodson (1965) found that bluegill in Pine Flat Reservoir fed largely on fish eggs, midge larvae, and cladocerans in spring, switching to flying insects in summer, and going back to midge larvae and cladocerans in winter. Growth is most rapid in water between 59 and 77°F.

*Striped Bass and American Shad*

Striped bass and American shad populations in reservoirs are limited to Millerton Lake, O'Neill Forebay, and San Luis Reservoir. Millerton Lake populations are maintained by spawning in the San Joaquin River upstream of the lake. This fishery is small but provides a valuable fishery.

Age at maturity for female striped bass is four to six years and two to four years with American shad. Spawning occurs in May and June when temperatures are between 59 and 68°F. Striped bass and American shad move upstream into the San Joaquin River from Millerton Lake and spawn in open water. High winter runoff and colder water temperatures can delay spawning until conditions become suitable. The eggs of both species are slightly heavier than freshwater, so they sink slowly as they are transported downstream. The eggs hatch in approximately two days, and the larvae are moved passively by the currents for seven to eight days. The larvae then begin feeding on small zooplankton in open water. Adult striped bass are open water predators and opportunistic feeders at the top of the food web, feeding on threadfin shad, smaller striped bass, and any other fish they can catch. By the end of their fourth year, Millerton Lake striped bass are typically 20 inches long and grow approximately 2 inches each year thereafter. American shad typically feed on large zooplankton and other invertebrates. The preferred temperature range for both species is 61 to 68°F.

***Factors Affecting Fisheries in Reservoirs***

Fishery management problems limiting optimal sport fishery development in Central Valley reservoirs were appraised as part of the Central Valley Fish and Wildlife Management Study (Leidy and Meyers 1984). Water-level fluctuation was the most frequently cited factor adversely affecting fishery production. The second principal environmental problem limiting sport fish production in reservoirs was the limited cover habitat available to fish as shelter. Millerton Lake experiences both fluctuating water levels and limited habitat cover. Eastman Lake experiences fluctuating water levels. The effects of fishing on reservoir fish communities are not well understood, although over fishing of naturally reproducing populations of game fishes seldom seems to be a problem (Moyle 1976). The following discussions primarily summarize Leidy and Myers (1984).

*Water-Level Fluctuations*

Extreme water-level fluctuation in reservoirs is perhaps the most significant environmental factor influencing reservoir fish populations. All three reservoirs associated with the Friant Division: Hensley, Eastman and Millerton Lakes-experience reservoir water-level fluctuation. The direct and indirect effects of fluctuating water levels are responsible to a large degree for limited cover habitat, limited littoral habitat, and shoreline erosion. Reservoirs in the Central Valley operate to store water during winter and spring and release water in summer and fall. This pattern of storage and releases results in variable, seasonal availability of water in reservoirs
.

Fluctuations can affect reservoir productivity directly in several ways. Water-level changes affect physical, chemical, and biological parameters, which in turn directly or indirectly affect fish populations.

*Excessive Harvest*

Eastman and Millerton Lakes experience overharvest of game fishes. Excessive harvesting of certain species or sizes of fish by anglers results in adverse effects on the fish population. In the long run, excessive angler harvest restricts the availability of fish to the angler. These reservoirs reported overharvest of largemouth and smallmouth bass. Excessive harvest of the largest bass results in a smaller average size of bass. The larger fish are mature adults that constitute much of the reproductive potential of the population. Removing these fish could reduce bass reproduction significantly. Overharvest results in a shift in the population to smaller, though mature, fish as the fishery becomes dominated by the progeny of small largemouth bass.

*Limited Cover Habitat*

The lack of adequate quantity or quality of cover habitat in reservoirs is a significant factor limiting production of warm-water fishery resources. The lack of cover restricts development of black bass, sunfish, and crappie populations. Cover provides shelter for these fish for spawning and rearing. Cover habitat also improves food availability.

The lack of established rooted aquatic vegetation is another problem common to reservoirs. A variety of factors, including fluctuating water levels, shoreline erosion, and cattle grazing, prevent vegetation from becoming established.

*Limited Spawning Habitat*

Water-level fluctuations during the spawning period at reservoirs can greatly reduce the productivity of largemouth bass. Spawning habitat can be degraded from sedimentation caused by shoreline erosion and exposure and desiccation because of fluctuating water levels.

*Water Quality Problems*

Low dissolved oxygen concentrations have affected fish populations at Hensley Lake in prior years. Decomposition of vegetation on the reservoir bottom consumes oxygen and releases hydrogen sulfide, which is highly toxic to fish.

***Life History of San Joaquin River Fishes Below Friant Dam***

***Chinook Salmon***

Adult Chinook salmon migrate up the San Joaquin River from the Delta to gain access to spawning and rearing areas in the Stanislaus, Tuolumne and Merced Rivers. These rivers provide the cold, freshwater sites with suitable gravel required for successful reproduction. Female Chinook salmon deposit their eggs in redds, or nests, which they excavate in the gravel areas with relatively swift water. The eggs are fertilized by one or more males. Fecundity varies among different populations and with body size. All adult Chinook salmon die after spawning. Females generally prefer gravel ranging from 1 to 6 inches in diameter, depths exceeding 0.5 foot, and water velocities ranging from 1.5 to 2.5 feet per second (Vogel and Marine 1991). There is no spawning in the San Joaquin River.

Incubation time is inversely related to water temperature. Eggs generally hatch in approximately six to nine weeks, and newly emerged fry remain in the gravel for another two to four weeks until the yolk is absorbed. Maximum survival of incubating eggs and larvae occurs at water temperatures between 41 and 56°F. Incubation only occurs in the tributaries of the San Joaquin River.

After emerging, Chinook salmon fry begin to feed and grow in the stream environment. Chinook salmon fry tend to seek shallow, near shore habitat with low water velocities and move to progressively deeper, faster water as they grow. In streams, Chinook salmon fry feed mainly on drifting terrestrial and aquatic insects, but zooplankton become more important in the lower river reaches and estuaries. Juveniles typically rear in freshwater for two to three months before migrating to sea. The San Joaquin River is used as a migration corridor for downstream moving fry and smolts and may be used for rearing as well. Chinook salmon in the Central Valley appear to exhibit stream-type (spring run) and ocean-type (fall-run) behavior (Healy 1991). An ocean-type life history pattern is characterized as having juveniles that migrate seaward as smolts in their first year of life and an adult stage that spawns shortly after entering freshwater. Juvenile Chinook salmon typically spend two to three months in freshwater before emigrating as smolts; this is the dominant pattern. Stream-type behavior is indicative of Chinook salmon that remain in freshwater for at least one year prior to emigrating as smolts and an adult stage that has a substantial freshwater residency time prior to becoming sexually ripe and spawning. Fall run Chinook is the only run of salmon remaining in the San Joaquin Basin.

During the smolting process, juvenile Chinook salmon undergo physiological, morphological, and behavioral changes that stimulate emigration and prepare them for ocean life. Chinook salmon spend two to four years maturing in the ocean before returning to their natal streams to spawn. Most Chinook salmon mature at two (primarily males) and three years of age, while a smaller proportion matures at four.

*Factors Affecting Chinook Salmon*

The following discussion highlights those factors that have been specifically identified as having important effects on Chinook salmon abundance in the San Joaquin River Basin and that can be altered by changes in project operations. Only life history stages using the mainstream San Joaquin River would be affected including adult upstream migration, rearing and juvenile out migration.

Upstream Migration

Flow. Flows from in the San Joaquin River have been inadequate during fall, resulting in delaying the upstream migration past Stockton or the straying of adult salmon into agricultural drainage ditches, primarily Mud and Salt sloughs. Barriers (electrical and physical) were installed across the San Joaquin River upstream of the Merced River confluence in 1992 to prevent salmon migration into these sloughs and help guide them into the Merced River.

Water Temperature. Hallock et al. (1970) found that Chinook salmon migrated into the lower San Joaquin River as water temperatures declined from 72 to 66 degrees Fahrenheit.

Water Quality. Low dissolved oxygen levels (less than 5 parts per million) and high water temperatures (greater than 66 degrees Fahrenheit) in the San Joaquin River near Stockton delayed or blocked the migration of adult Chinook salmon during the 1960s (Hallock et al., 1970). Since 1964, fall migration problems have been reduced by improved wastewater treatment and installation of a physical barrier at the head of Old River in dry years to direct most of the San Joaquin flows down the main channel past Stockton. Despite these efforts, low dissolved oxygen levels recurred during recent drought conditions. Proposed remedial measures include increasing tributary outflow, evaluating and monitoring dredging activity in the Delta, and further evaluating the fall barrier at Old River (San Joaquin River Management Council 1992).

Juvenile Rearing

Flow. Streamflow has been identified as the primary factor affecting abundance of Chinook salmon stocks in the San Joaquin River Basin. Streamflow reductions after April and May in the Merced and Tuolumne rivers result in poor survival conditions for Chinook salmon juveniles that remain in these tributaries beyond these months. High mortality generally results from reduced living space, high water temperatures, and increased predation. Current interim instream flow requirements in the Stanislaus River provide adequate flow conditions through the Chinook salmon rearing period.

Water Temperature. Generally, water temperatures below major dams on the San Joaquin River tributaries become unsuitable for Chinook salmon rearing in May or June, causing high mortality of juvenile Chinook salmon that have not yet emigrated. In the Stanislaus River, however, releases of cold hypolimnetic water from New Melones Reservoir have improved water temperatures during the late spring rearing period relative to pre-impoundment conditions (Reclamation 1986b).

Juvenile Emigration

Spring flows in the San Joaquin River and major tributaries during the Chinook salmon emigration period appear to have a major influence on the number of adults returning to the San Joaquin River Basin. Positive correlations exist between spring flows in the San Joaquin River and total Chinook salmon spawning escapement 2.5 years later. Greater inflow has been required to maintain Chinook salmon escapement after the operation of the SWP. Similar relationships for San Joaquin River tributary stocks indicate that the flow required to maintain a given spawning escapement level increased following operation of the CVP and SWP. Over time, increases in the significance of other mortality factors, such as increased Delta exports, have diminished the positive effects of incremental increases in spring flows. (DFG 1987.)

Smolts migrating down the San Joaquin River and through the southern Delta frequently encounter low flows, high temperatures, and high diversion rates. Currently proposed spring outflow recommendations for the Merced, Tuolumne, and Stanislaus rivers are designed to improve survival of juvenile salmon migrating down the tributaries, the mainstem San Joaquin River, and through the Delta. Recent evaluations have focused on the effectiveness of releasing short-duration, high-amplitude flows (i.e., pulsed flows) from tributary streams in conjunction with reduced Delta exports.

Declining streamflow during the spring emigration period of fall-run Chinook salmon coincides with rising air temperatures and increased agricultural return flows to the San Joaquin River, often resulting in deleterious water temperatures along much of the emigration route in the lower San Joaquin River. In May, water temperatures in the San Joaquin River near Vernalis often reach high chronic stress levels (greater than 67.6 degrees Fahrenheit) at flows of 5,000 cfs or less. Under these conditions, up to half the production of San Joaquin River Chinook salmon can be subjected to harmful water temperatures. (DFG 1987b).

***Steelhead Trout***

Life history aspects of the few steelhead in the San Joaquin River system are likely similar to those described for the Sacramento River system. Although remaining steelhead use the mainstem San Joaquin River as a migration corridor, there is very little known about present steelhead use of the San Joaquin River. Upstream spawning migration runs in the Mokelumne River extend from September through January (DFG 1991).

Steelhead are generally classified into two races, depending on whether they begin their upstream migration in winter or summer. Historically, only winter steelhead trout were native to the Sacramento River Basin. However, summer steelhead have been introduced into the basin, along with strains of winter steelhead from the Eel, the Mad, the Rogue (Oregon) and the Washougal (Washington) river basins. Because of these introduced individuals, the genetic composition of the native steelhead trout within the Central Valley could be compromised.

It is possible that adult steelhead can be found in freshwater during every month of the year due to the influence of introduced genetic strains, modified and unnatural flow and/or temperature regimes throughout the basin.

*Factors Affecting Steelhead Trout*

Upstream Migration

Upstream migration occurs generally from July through February, depending on prevailing flow and temperature conditions. On the Sacramento River tributaries, relatively early attraction of steelhead trout can be triggered by occasional reservoir releases of cold water and natural high-water conditions. The upstream migration run can consist of both sexually mature adults and immature individuals who have spent only a few months at sea.

The smaller steelhead, sometimes called fall steelhead, begin entering the river in July, peak in November, spawn primarily in late December and January, and complete spawning by mid-February. The larger winter steelhead migrate upstream during mid-December through February, spawn in late January through early March, and complete spawning by April 1. Steelhead stocks in the Sacramento River appear to respond to environmental conditions to a greater degree than do pure native stocks. While adult steelhead are in freshwater, they rarely eat and consequently grow very little (Pauley et al. 1986).

Spawning

There has not been any recent documented steelhead spawning in the mainstem of the San Joaquin River.

Juvenile Rearing

Unlike Chinook salmon, steelhead rear year round in the tributary streams. There is no steelhead rearing in the mainstem San Joaquin River.

Juvenile Emigration

With most stocks of steelhead, juveniles emigrate downstream to the ocean in November through May (Schaffter, 1980); however, most Sacramento River steelhead migrate in spring and early summer (Flosi et. al., 1998). Sacramento River steelhead generally migrate as one-year-olds at a length of 6 to 8 inches (Barnhart 1986; Reynolds et al. 1993). Emigration rates are influenced by water temperatures and current velocities. Although some steelhead have been collected in most months at the state and federal pumping plants in the Delta, the peak numbers salvaged at these facilities have been primarily in March and April in most years.

***Factors Affecting Abundance***

Factors affecting steelhead trout abundance in the San Joaquin River Basin are similar to those described in detail for San Joaquin River fall-run Chinook salmon. The primary factors limiting abundance and distribution are dams, water diversions, poor water quality, and riparian impacts. Low summer flows and concurrent high water temperatures preclude the necessary year-round rearing habitat for steelhead trout below the impassable dams (Friant, Crocker Huffman, LaGrange, Goodwin, and Camanche) on the mainstem San Joaquin River and its major tributaries.

***Sacramento Pikeminnow***

The Sacramento pikeminnow (formerly Sacramento squawfish) is common in the larger intermittent and permanent streams of the Sierra Nevada foothills and valley floor. While pikeminnow do best in undisturbed streams, they are however, still found in the San Joaquin River below Friant Dam. Pikeminnow spend much of their time in deep, well-shaded pools of clear streams. They do not do well in disturbed environments where abundant introduced species occur.

Pikeminnow are predatory fishes, and prior to the introduction of other large piscivorus species, were undoubtedly at the top of the aquatic food chain in the Central Valley and surrounding foothills. Pikeminnow feed throughout the water column on a variety of prey. Prey item selection is dependent on availability, season and other species present. Pikeminnow will exploit potential prey not being utilized by other competing species. Typically, pikeminnow less than 7 inches will feed on aquatic insects, while pikeminnow greater than 7 inches will feed on other smaller fish.

Adult pikeminnow are rather sedentary in habit; they can found in the same habitat for much of their life. There they spend much of their time under submerged rocks or logs, where they ambush their prey. At dusk they will come out and actively forage for food. Juveniles swim about in schools in shallow water of large stream pools or reservoirs.

Growth in Sacramento pikeminnow varies by season and habitat. Pikeminnow grow fastest from the time they hatched from their eggs in May until the stream flows recede in July. Some growth takes place again during the winter months when stream flows increase, though colder temperatures probably keep the fish from growing as fast as they do in the early summer months. Fish in larger permanent streams also grow faster than in small intermittent streams.

Sacramento pikeminnow are sexually mature by the third or fourth summer at approximately 8 inches. Ripe fish migrate upstream in April and May to spawn in gravel riffles when temperatures exceed 57 degrees Fahrenheit. In reservoirs they may spawn in gravel areas close to shore.

*Factors Affecting the Sacramento Pikeminnow*

Spawning

Spawning behavior is probably similar to that of the northern pikeminnow. During spawning, large numbers of pikeminnow congregate over a gravel substrate where a single female may be pursued by up to six males. Spawning takes place when the female dips close to the bottom and releases a small amount of eggs, which are simultaneously fertilized by one or more males that are in her company. The fertilized eggs continue to sink where they adhere to the bottom.

Egg Incubation and Emergence

In northern pikeminnow, the eggs hatch in four to seven days at 64 degrees Fahrenheit. In another seven days the fry then begin schooling in the shallows.

Factors Affecting Abundance

*Introduced Species*

Introduced species are perhaps the greatest threat to native cyprinids in the Central Valley. Predation from large piscivorus fishes, such as largemouth bass have reduced the abundance (or extirpated) of many native cyprinid species.

*Flow*

Receding water levels can expose eggs to desiccation. Reduced flows may also limit the available habitat. Deep pools may become too shallow and no longer suitable to pikeminnow.

*Temperature*

Temperatures outside the preferred life history ranges will have an adverse affect on the pikeminnow population. Unseasonal temperatures below the preferred range may stunt growth or delay spawning or hatching.

*Largemouth Bass*

The life history of largemouth bass in the San Joaquin River below Friant Dam is similar to their life history in reservoirs.

## ENVIRONMENTAL CONSEQUENCES

Potential environmental consequences of the project include changes in the timing of surface water storage and flows because of changes to the timing when CVP water is purchased. For fishery issues, these equate to changes in the timing of water moving through the canals, changes in the timing of water storage in Millerton Lake and/or changes in the timing of streamflows in the San Joaquin River. These potential effects are discussed below.

### ***No Action Alternative***

Water use is expected to continue as it has using both CVP surface water supplies and groundwater. Groundwater has typically been more important during dry years when CVP water is less available. The surface water resources of the San Joaquin River under the NAA are discussed in the Preferred Alternative of the PEIS.

### ***Alternative 1***

Alternative 1 is similar to the NAA. Therefore, there are no impacts to fishery resources under this alternative.

***Alternative 2***

The analysis of the blended water pricing structure indicates that in some periods, contractors will purchase less CVP water and rely more on groundwater (CH2M Hill 2000). The largest shift would occur in a wet year following five dry years in subbasin 13. According to the economic analysis, this situation would result in a reduction of surface water use of approximately 113,100 af in one subregion from Millerton Lake. This water would remain in Millerton Lake until purchased by other users.

*Change in Canal Flows in Certain Years*

The distribution of this water and resultant canal flows is speculative and depends on many factors. However, because of current unmet demand and the level of historic transfers, no change could occur in the operation of Millerton Lake.

*Changes in Reservoir Storage in Certain Years*

Under the current operations, the water in Millerton Lake would not be carried over to the following year. Maintaining storage in Millerton may improve conditions for spawning largemouth and smallmouth bass and other sunfishes in the spring if such storage results in more stable water surface elevations during the spawning season. This would be considered beneficial.

*Changes in Surface Flows in the San Joaquin River in Certain Years*

If early year purchases decline and unsold water is held in Millerton Lake until the fall, water could be released to the San Joaquin River. It this does occur, it could result in attracting fall-run Chinook salmon into the San Joaquin River or improving passage to the tributaries. This would be considered a beneficial impact for passage, but would only result in a beneficial impact for spawning if the attracted salmon could successfully spawn and their juveniles could successfully outmigrate from the San Joaquin River.

## Cumulative Effects

Alternative l and 2 have little or no effect on surface water quantities and flows. Therefore, they do not contribute to any cumulative effects.

Restoration projects on the San Joaquin River may improve conditions for salmon in the near future. The restoration actions will likely increase demand on surface water supplies, as well. Improvements in the condition of the San Joaquin River may come at the expense of Millerton Lake storage if more water is required in the spring for salmon smolt outmigration and in the fall for the adult salmon upstream migration. This would have an adverse effect on the fishery resources of Millerton Lake, while providing a benefit to fishery resources in the San Joaquin River. The exact nature of these effects cannot be determined at this time.

## LAND USE RESOURCES

### Affected Environment

The Friant Division of the Central Valley Project delivers water to approximately 860,000 acres of irrigated farmland and several metropolitan areas on the east side of the southern San Joaquin Valley (Figure PN-1). Covering parts of five counties (Merced, Madera, Fresno, Tulare, and Kern) and stretching from Chowchilla on the north to the Tehachapi Mountains on the south, the Friant Division delivers irrigation and municipal and industrial (M&I) water to 28 contractors with contract entitlements totaling 2,249,475 af (Table LU-1).

**Table LU-1**
**Long-Term Agricultural Water Supply Contracts in the Friant Service Area**

| Contract Type/Contractor | Contract Amount (acre-feet) | (acre-feet) |
|---|---|---|
| **Friant-Kern Canal Service Area** | | |
| Arvin-Edison WSD | 40,000 | 311,675 |
| Delano-Earlimart ID | 108,800 | 74,500 |
| Exeter ID | 11,500 | 19,000 |
| Fresno ID | | 75,000 |
| Garfield WD | 3,500 | |
| International WD | 1,200 | |
| Ivanhoe ID | 7,700 | 7,900 |
| Lewis Creek WD | 1,450 | |
| Lindmore ID | 33,000 | 22,000 |
| Lindsay-Strathmore ID | 27,500 | |
| Lower Tule River ID | 61,200 | 238,000 |
| Orange Cove ID | 39,200 | |
| Porterville ID | 16,000 | 30,000 |
| Saucelito ID | 21,200 | 32,800 |
| Shafter-Wasco ID | 50,000 | 39,600 |
| Southern San Joaquin MUD | 97,000 | 50,000 |
| Stone Corral ID | 10,000 | |
| Tea Pot Dome WD | 7,500 | |
| Terra Bella ID | 29,000 | |
| Tulare ID | 30,000 | 141,000 |
| **Subtotal Friant-Kern Canal Service Area** | **595,750** | **1,041,475** |
| | | |
| **Madera Canal Service Area** | | |
| Chowchilla WD | 55,000 | 160,000 |
| Madera ID | 85,000 | 186,000 |
| **Subtotal Madera Canal Service Area** | **140,000** | **346,000** |
| | | |
| **Downstream San Joaquin River Service Area** | | |
| Gravelly Ford WD | | 14,000 |
| **Total Long-Term Friant Division Ag Water Supply Contracts** | **735,750** | **1,401,475** |

**Table LU-1**
**Long-Term Agricultural Water Supply Contracts in the Friant Service Area**

| Contract Type/Contractor | Contract Amount (acre-feet) | (acre-feet) |
|---|---|---|
| ***Long-Term Friant Division M&I Industrial Water Supply Contracts*** | | |
| City of Fresno | 60,000 | |
| City of Orange Cove | 1,400 | |
| City of Lindsay | 2,500 | |
| Fresno County Water Works District No. 18 | 150 | |
| Madera County | 200 | |
| **Total Long-Term Friant Division M&I Water Supply Contracts** | **64,250** | |
| | | |
| **Buchanan Unit[1]** | | |
| Chowchilla WD | 24,000 | |
| | | |
| **Hidden Unit[1]** | | |
| Madera ID | 24,000 | |
| **Total Buchanan and Hidden Units** | **48,000** | |
| | | |
| **Total Long-Term Friant Division Water Supply Contracts (Class 1 and 2)** | | **2,249,475** |

Note: [1] Buchanan and Hidelon Units are not part of the Friant Division but are geographically located in the Friant service area.

The water is delivered to the contractors from Millerton Lake (Friant Dam) via the Friant-Kern and Madera Canals, except for Gravelly Ford Water District, which receives its water from the San Joaquin River downstream of Friant Dam and two M&I contractors (Fresno and Madera Counties), which take their water directly from Millerton Lake.

The Buchanan Unit contract (Eastman Lake, Buchanan Dam) and the Hidden Unit contract (Hensley Lake, Hidden Dam), supply water to Chowchilla Water District and Madera Irrigation District, respectively. Buchanan and Hidden Units are not part of the Friant Division, however, they are geographically located in the Friant service area.

Water is also delivered to eight Cross Valley Contractors and their subcontractors from Millerton Lake under a complex exchange agreement that allows for the exchange of equivalent amounts of water between Arvin-Edison Water Storage District (a long-term Friant Division contractor) and eight entities that contract for water with the United States out of Shasta Dam and Reservoir. These eight Cross Valley Canal Exchange Contractors and the renewal of their contracts are covered in a separate environmental assessment.

The Friant Division of the CVP was designed and built to provide irrigation water to supplement the ground water usage in the area, thereby helping to alleviate the overdraft. The allocation of CVP water utilizes a two-class system. Class 1 is considered a firm supply amounting to the first 800,000 af of yield from the San Joaquin River and Millerton Lake. Class 2 water only develops after Class 1 allocations have been fully met. Class 1 water contracts are generally with contractors whose service area have limited or no access to good quality ground water. Class 2 water is typically under contract to those districts that have access to good ground water supplies and can accept recurring deficiencies by utilizing the available ground water as their primary source of water during these times. These areas generally have excellent recharge capabilities which are utilized in wet years to store excess available water underground for use in times of reduced surface water deliveries.

### *Agricultural Land Use*

The Friant Division supplies 23 districts with primarily irrigation water. These 23 districts range in size from approximately 600 acres to over 170,000 acres, totaling over 856,000 acres of irrigated land. There are over 14,000 farming entities in the 23 districts that average 58 acres in size (Table LU-2). The actual number of landowners is much higher than the number of farming entities because many farming entities farm lease lands in addition to owned land.

**Table LU-2**
**Listing of Irrigated Acreage and Farm Size for the Friant Division Long-Term Contractors**[1]

| Contractor | Approx. No. of Farming Entities | Irrigated Acreage (acres) | Average Operating Farm Size (acres) |
|---|---|---|---|
| **Friant Division Long-Term Contractors** | | | |
| Arvin-Edison WSD | 300 | 99,251 | 330 |
| Chowchilla WD | 319 | 58,637 | 184 |
| Delano-Earlimart ID | 200 | 51,082 | 255 |
| Exeter ID | 376 | 12,242 | 33 |
| Fresno ID | 9,000 | 172,073 | 19 |
| Garfield WD | 33 | 1,698 | 52 |
| Gravelly Ford WD | 60 | 8,982 | 150 |
| International WD | 7 | 572 | 82 |
| Ivanhoe ID | 450 | 10,613 | 24 |
| Lewis Creek WD | 35 | 942 | 27 |
| Lindmore ID | 687 | 24,097 | 35 |
| Lindsay-Strathmore ID | 548 | 12,724 | 23 |
| Lower Tule River ID | 259 | 89,772 | 347 |
| Madera ID | 394 | 95,648 | 240 |
| Orange Cove ID | 462 | 25,151 | 54 |
| Porterville ID | 115 | 13,932 | 121 |
| Saucelito ID | 87 | 18,064 | 208 |
| Shafter-Wasco ID | 230 | 30,849 | 134 |
| Southern San Joaquin MUD | 260 | 50,468 | 194 |
| Stone Corral ID | 59 | 5,345 | 90 |
| Tea Pot Dome WD | 116 | 3,037 | 26 |
| Terra Bella ID | 380 | 11,244 | 30 |
| Tulare ID | 308 | 60,600 | 197 |
| **Total Friant Division Long-Term Contractors** | **14,685** | **856,033** | **58** |

Source: FWUA 1998
Note:
[1] Source year for irrigated acres unknown

The Central Valley of California is a vital agricultural region for both California and the United States. In 1998, Central Valley counties accounted for approximately 60 percent of California's agricultural production in terms of gross value. The Friant Division delivers water to portions of five counties (Fresno, Tulare, Kern, Merced, and Madera), which alone account for $8.91 billion in gross agricultural production, or 33 percent of California's total (Table LU-3). The leading agricultural commodities in the counties served by the Friant Division are grapes, milk, cotton, almonds, and citrus, which accounted for nearly $4 billion in gross agricultural production in 1998.

**Table LU-3**
**Ranking of Friant Division Counties by Total Value of Agricultural Production [1]**

| 1998 CA Rank | County | 1998 Production ($1,000) | Percent of Total CA Value | Cumulative Percentage | Leading Crops |
|---|---|---|---|---|---|
| 1 | Fresno | 3,286,806 | 12.2 | 12.2 | Grapes, poultry, cotton, tomatoes, milk |
| 2 | Tulare | 2,922,057 | 10.8 | 23.0 | Milk, oranges, grapes, cattle & calves, alfalfa |
| 4 | Kern | 2,067,678 | 7.7 | 30.7 | Grapes, citrus, almonds, cotton, milk |
| 5 | Merced | 1,449,754 | 5.4 | 36.1 | Milk, chickens, almonds, tomatoes, alfalfa |
| 12 | Madera | 634,307 | 2.4 | 38.5 | Grapes, milk, almonds, pistachios, alfalfa |
| **Five-County Total** | | **10,360,602** | | | |
| **Total California** | | **26,941,832** | | | |

Source: USDA 1999
Note:
[1] Production value numbers are for the entire county which includes farmland not served by the Friant Division.

In 1996, over 60 different crops, totaling almost 874,000 acres, were produced within the Friant Division service area. These various crops are summarized using the 22 categories developed by Reclamation as part of its water needs analysis for LTCR negotiations with CVP contractors (Table LU-4). Each crop group name represents crops with similar seasonal crop water requirements. The 1996 crop acreage exceeds the total irrigated acreage in the Friant Division service area because of double cropping.

**Table LU-4**
**Central Valley Project – Friant Division 1996 Crop Acreages[1]**

| Reclamation Crop Group Name | Acres |
|---|---|
| Alfalfa | 66,801 |
| Almonds | 84,318 |
| Barley | 3,838 |
| Beans (dry) | 4,880 |
| Corn (field) | 59,172 |
| Cotton | 102,091 |

**Table LU-4**
**Central Valley Project – Friant Division 1996 Crop Acreages[1]**

| Reclamation Crop Group Name | Acres |
|---|---|
| Deciduous Orchard | 38,936 |
| Grain Sorghum (milo) | 972 |
| Grains | 14,405 |
| Melons | 3,663 |
| Miscellaneous Truck/Field Crops (high) | 1,891 |
| Miscellaneous Truck/Field Crops (low) | 3,452 |
| Miscellaneous Truck/Field Crops (medium) | 41,222 |
| Nursery/Lettuce | 3,465 |
| Pasture (improved) | 15,765 |
| Potatoes | 25,192 |
| Subtropical Orchard | 142,209 |
| Sugar Beets | 1,139 |
| Tomatoes | 3,210 |
| Vineyard | 226,884 |
| Wheat | 30,289 |
| **Total** | **873,794** |

Source: Reclamation 2000

[1]The crop acreage numbers include 1995 data for Garfield WD, International WD, Lewis Creek WD, and Orange Cove ID because 1996 data were unavailable.

### *Municipal and Industrial Land Use*

Most of the region's population is located on the east side of the valley, in or near the CVP Friant Division service area. The major population centers in, or near, the Friant Division service area are Fresno, Clovis, Visalia, and Tulare. Other population centers in the area include Madera, Porterville, and Bakersfield. The population of the region in 1995 was approximately 1.8 million and is projected to be greater than 3.3 million by 2020 (DWR 1999).

Water for these communities and other M&I users on the east side of the southern San Joaquin Valley comes almost entirely from pumping of ground water. The quality of the ground water is generally good and, for the most part, does not have to be treated prior to use. However, the CVP is the sole source of water for the cities of Orange Cove, Lindsay, Strathmore, and Terra Bella. Also, the town of Friant and the Hidden Lakes Estates development, near Millerton Lake, take their domestic water supply directly from Millerton Lake under the Fresno and Madera County contracts, respectively. In addition, several districts' contracts allow them to deliver an incidental amount of their agricultural contract entitlement for M&I purposes.

The largest M&I contract is for 60,000 af with the City of Fresno. To date, the City of Fresno has not used any CVP water directly for M&I purposes but has used its supply to recharge the ground water basin in the area. Fresno has plans to build a water treatment plant in the near future to begin treating and delivering CVP water directly to city customers. Both Clovis and Bakersfield also participate in or operate ground water recharge programs that utilize, in part, CVP water. The five Friant Division M&I

contracts total 64,250 af and represent less than three percent of the total Friant Division contracts (Table LU-1).

***Conversion of Agricultural Land to Alternative Uses***

A major issue for San Joaquin Valley and its agricultural-based economy is the continual conversion of farmland to urban uses. The *California Water Plan Update, Bulletin 160-98* predicts that over 130,000 acres of irrigated crop acreage will come out of production between 1995 and 2020. Although retirement of agricultural land on the west side of the valley from irrigated crop production to dryland farming or wildlife habitat will account for a significant portion of this acreage, conversion of agricultural lands to urban uses will account for much of the predicted 130,000-acre decrease. During the period 1992 to 1997, of the counties receiving Friant Division irrigation water deliveries, only Fresno County showed an increase in the amount of lands in farms and an increase in the average size of farms (Table LU-5).

**Table LU-5**
**Agricultural Land Trends, 1992-1997**

| County | Land in Farms (acres) | | | Average Size of Farms (acres) | | |
|---|---|---|---|---|---|---|
| | 1992 | 1997 | Percent Change | 1992 | 1997 | Percent Change |
| Fresno | 1,774,664 | 1,881,418 | 12.2 | 253 | 285 | +13 |
| Madera | 749,465 | 641,546 | -14 | 439 | 383 | -13 |
| Merced | 978,851 | 881,696 | -10 | 340 | 311 | 09 |
| Tulare | 1,354,262 | 1,309,525 | -3 | 248 | 240 | -3 |
| Kern | Not available | | | | | |

Source: USDA 1997

Agricultural lands receiving CVP water that are converted to urban uses, historically have not continued use of CVP water. The land use change generally results in a change in water supply as well, from agricultural to a urban community water system. Ground water is generally preferred for a community water system. The CVP water is generally reallocated to other agricultural lands in the district or used to recharge ground water.

## Environmental Consequences

The following assumptions were used in the impact analysis:

- Contracts will be renewed under all alternatives.

- No new expansion of CVP deliveries or place of use will occur during the contract period of 25 years.

- No new farmland will be brought into production during the contract period of 25 years.

- No additional land retirement beyond that assumed in the Central Valley Project Improvement Act (CVPIA) Programmatic Environmental Impact Statement (PEIS).

***Growth-Inducement Impacts***

Under NEPA, the potential for growth-inducing impacts as indirect effects of a project are to be considered. A project will not cause an indirect effect unless the effect would not occur "but for" the project. The growth-inducing impact evaluation is based on whether the implementation of Alternative 1 or 2 for the Friant Division would result in increased growth, and the presumed growth and impact to protected species is reasonably certain to occur. Based on the following factors, the implementation of Alternative 1 or 2 as compared to the NAA would not result in growth-inducing impacts in the Friant Division.

- The purpose of this project is to renew water service contracts, consistent with the provisions of CVPIA. This would continue beneficial use of water developed and managed as part of the CVP, with a reasonable balance among competing demands, including the needs of irrigation and domestic uses; fish and wildlife protection, restoration, and mitigation; fish and wildlife enhancement; power generation; recreation; and other water uses, consistent with requirements imposed by the State Board and the CVPIA.

- The LTCRs do not include an increase in the total contract volumes and will be limited by the existing CVP contract. Because there is no new water, the contract does not induce greater economic development or growth in the Study Area.

- The LTCRs do not involve construction, enlargement, or alteration of the facilities in the Study Area. The construction of new CVP facilities or enlargement of existing conveyance systems are not included in the LTCRs to induce growth.

- Considering the decreased availability of CVP water to contractors and the predicted fallowing of agricultural lands, it is not likely that the Contractors will be converting native lands to agricultural lands as a result of implementing Alternatives 1 or 2.

- Reclamation's South-Central California office is working with the Service and the water authorities to establish guidelines for land conversions.

The primary factors that will impact land use are the availability and price of water. Water supply availability and pricing mechanisms of the alternatives are discussed in Section 2 - Description of Alternatives.

***Alternatives Impact Analysis***

The technical memorandum "Economic Analysis of November 1999 Tiered Pricing Proposal for PEIS Alternative" (CH2M Hill, 2000) updated the economic analysis presented in the PEIS using 1999 water rates and Reclamation's November 1999 Tiered Pricing Proposal (Category 1 and 2 water).

The analysis presented in the memorandum applied the new water rates and the November 1999 proposal to the PEIS Preferred Alternative and compared the results to the impact analysis of the PEIS Preferred Alternative. The PEIS Preferred Alternative is this EA's NAA and the basis for its land use impact analysis. The impacts of EA Alternative 1 are assumed to be identical to the impacts to the NAA because the water supply and pricing scenarios are identical in both alternatives. The only differences in the alternatives are administrative.

The comparison of the 1999 water rates and Reclamation's tiered pricing proposal to the PEIS Preferred Alternative is equivalent to a comparison of this EA's NAA and Alternative 2.

***Agricultural Land Use***

The agricultural land use and economic analysis in the technical memorandum assumed that contractors blend the price of all CVP water received at tiered prices into a single rate. Tiered rates to growers are assumed in the PEIS.

The modeling and underlying data were the same as used in the PEIS. Ground water hydrology was not assessed as it was in the PEIS alternatives. Therefore, for purposes of analysis, most regions were assumed to have access to replacement ground water if needed, including the Friant Division.

The economic analysis and data presented in the technical memorandum were derived from the Central Valley Production Model (CVPM) which was used in the PEIS. This model breaks crop production down into regions and subregions. The Friant Division service area is contained within the Tulare Lake Region, and the Buchanan and Hidden Units are in the San Joaquin Region. At the subregion level, the Friant Division service area is contained in subregions 13, 16, 17, 18, 20 and 21, but does not account for all of the acreage included in the CVPM for these subregions. The CVPM also includes non-CVP lands in its analysis. The Friant Division lands represent approximately 40 percent of the land included in the six subregions and therefore the irrigated acreage in the Affected Environment will not match the irrigated acreage used in this impact analysis. However, for this analysis, the impacts generated by the CVPM for subregions 13, 16, 17, 18, 20 and 21 will be considered the same as the impacts to the Friant Division.

<u>*No Action Alternative*</u>

The NAA and Alternative 1 irrigated acreage numbers are assumed to be the same as those shown in the table for the PEIS Preferred Alternative.

Table LU-6 summarizes the estimated irrigated acres by subregion for the NAA and Alternative 1. The estimated irrigated acreage in the six subregions for an average water year is 2,058,500 acres. In a wet year the total irrigated acreage of the six subregions increases only by an estimated 4,800 acres or approximately 0.2 percent. In a dry year the irrigated acreage within the six subregions is estimated to decrease by an estimated 26,600 acres, or approximately 1.3 percent.

**Table LU-6**
**Irrigated Acreage, No Action Alternative**

| Subregion | Average Year | Wet Year | Dry Year |
|---|---|---|---|
| 13 | 532.5 | 534.1 | 531.6 |
| 16 | 111.4 | 111.8 | 111.3 |
| 17 | 260.1 | 260.3 | 255.3 |
| 18 | 592.5 | 594.9 | 577.2 |
| 20 | 202.9 | 203.0 | 199.3 |
| 21 | 359.2 | 359.2 | 357.2 |
| **Total** | 2,058.6 | 2,063.3 | 2,031.9 |

Source: CH2M Hill, 2000
Note: All values in thousands of af.

These changes are relatively small because of the high percentage of land in the subregions planted in permanent crops and ground water is available as a replacement for decreased CVP supplies. The subregion which shows the greatest decrease in irrigated acres in a dry year is subregion 18. This is due to the large average amount of cotton grown in the subregion, and the fact that the CVPM attributes acreage reduction in dry years primarily to cotton and other row crops, such as alfalfa.

*Alternative 1*

As previously stated, for this analysis the NAA and Alternative 1 are assumed to have the same environmental consequences because of their similarities and the fact that the only differences are contractual arrangements among the parties to the contracts.

*Alternative 2*

Alternative 2 includes tiered water prices based on the November 1999 proposal to the Preferred Alternative and 1999 water rates. The impacts to irrigated acreage within the six subregions are detailed in the CH2M Hill technical memorandum (CH2M Hill 2000) and is summarized in Table LU-7. The table shows the comparison of average, wet, and dry NAA irrigated acreage to the Alternate 2 acreages estimated to be irrigated in average, wet, and dry years following a series of average, wet, and dry years (5-year average-Category 1 water). The number of acres shown in Table LU-7 include all of the land in the subregions (CVP and non-CVP) and is assumed to represent the impacts to the Friant Division.

**Table LU-7**
**Irrigated Acreage Alternative 2**

| | | Changes compared to Average NAA | | | | Changes compared to Wet NAA | | | | Changes compared to Dry NAA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Avg | Wet | Dry | | Avg | Wet | Dry | | Avg | Wet | Dry |
| Subregion | NAA Avg. | Followed by Average | | | NAA Wet | Followed by Wet | | | NAA Dry | Followed by Dry | | |
| 13 | 532.5 | 0.0 | 0.0 | 0.0 | 534.1 | -.09 | -.09 | -1.1 | 531.6 | -.09 | -.09 | -.09 |
| 16 | 111.4 | -.01 | -.01 | 0.0 | 111.8 | -.04 | -.04 | -.04 | 111.3 | -.01 | -.01 | -01 |
| 17 | 260.1 | 0.0 | 0.0 | 0.0 | 260.3 | 0.0 | 0.0 | 0.0 | 255.3 | 0.0 | 0.0 | 0.0 |
| 18 | 592.5 | 0.0 | 0.0 | -0.1 | 594.9 | -1.2 | -1.2 | -1.2 | 577.2 | 0.1 | 0.1 | 0.1 |
| 20 | 202.9 | 0.0 | 0.0 | 0.0 | 203.0 | 0.0 | 0.0 | 0.0 | 199.3 | 0.0 | 0.0 | 0.0 |
| 21 | 359.2 | 0.0 | 0.0 | 0.0 | 359.2 | 0.0 | 0.0 | 0.0 | 357.2 | 0.0 | 0.0 | 0.0 |
| **Total** | 2,058.6 | -0.1 | -0.1 | -0.1 | 2,063.3 | -2.5 | -2.5 | -2.7 | 2,031.9 | -0.9 | -0.9 | -0.9 |

Source: CH2M Hill, 2000
Note:
All values in thousands of af.

In all average years under Alternative 2 there is virtually no change in irrigated acreage as compared to the NAA average year. For all dry years under Alternative 2 there is virtually no change in irrigated acreage as compared to the NAA dry year except in subregion 13. Subregion 13 shows a reduction of 900 acres in dry years under Alternative 2 which is composed of reductions in pasture, alfalfa, and cotton acreages. In wet years under Alternative 2, there are reductions in irrigated acres of 2,500 to 2,700 acres as compared to the NAA wet year. These reductions occur in subregions 13, 16 and 18 are comprised of reductions in alfalfa, pasture, cotton and other field crop acreages.

The greatest reduction in irrigated acreage, is when a wet year follows a series of dry years. Even so, the 2,700 acre reduction represents a reduction of only 0.1 percent over the NAA wet year acreage of 2,063.2 acres. This is expected under the Category 1 and 2 tiered pricing structure. Following a series of dry years, the amount of Category 1 water would be small because it is based on the average of the last five years deliveries. When a wet year follows, the amount of Category 2 water would be large and it is priced at full cost, therefore raising the overall blended rate of CVP water. These higher costs for CVP water lead to land following and conversion to ground water.

## Cumulative Effects

The implementation of any of the three alternatives along with any other foreseeable actions would have little or no impact on agricultural and M&I land use in the Friant Division. Therefore, the implementation of any of the three alternatives would not result in cumulative impacts that would substantially alter historical agricultural or M&I land uses.

## BIOLOGICAL RESOURCES

### Affected Environment

The Friant Division covers an extensive area in San Joaquin Valley including parts of Madera, Fresno, Tulare, and Kern counties. The Friant Division also includes Millerton Lake (Friant Dam) and riparian zones along the Chowchilla, Fresno, and San Joaquin Rivers. Eastman Lake (Buchanan Dam) and Hensley Lake (Hidden Dam) are in the Buchanan and Hidden Units, respectively. Although not considered a part of the Friant Division, these units provide CVP project water to Friant Division Contractors and are presented with the Friant Division.

All three reservoirs are in proximity to one another and are approximately at the same elevation (600 ft.), thus all support similar habitats. The primary habitats that occur in the vicinity of these lakes are limnetic or lacustrine, annual grassland and blue oak woodland. Annual grassland is found on the western edges of Millerton and Hensley lakes, and makes up the understory of the blue oak woodland as well.

The following sections discuss the vegetation and wildlife resources within the regional area of the Friant Division that may be affected by water supplies delivered in accordance with the renewed water service contract. Appendix A presents a county list of federal and California State special- status species that are known to inhabit areas within the valley floor.

Non-native annual grasses, favored for livestock grazing, provide most of the vegetative cover in these annual grasslands. Ripgut brome (*Bromus diandrus*), soft chess (*B. hordeaceus*), wild oats (*Avena fatua*), and rat-tail fescue (*Vulpia myuros*) are the most common grasses. Red-stemmed and broad-leaf filaree (*Erodium cicutarium* and *E. botrys*, respectively) are typical non-native forbs. Native forbs common to this community during the spring include rusty popcornflower (*Plagiobothrys nothofulvus*), Eastwood's fiddleneck (*Amsinckia intermedia var. eastwoodeae*), and Chile trefoil (*Lotus subpinnatus*). During August and September dense stands of Heerman's tarweed (*Holocarpha heermanii*) can be found interspersed with turkey mullein (*Eremocarpus setigerus*) and vinegar weed (*Trichostema lanceolatum*).

Annual grasslands provide habitat for a variety of amphibian and reptile species. The Gilbert's skink (*Eumeces gilberti*) and western fence lizard (*Sceloporus occidentalis*) occur here, especially along fence lines and grassland edges where they are close to cover. Gopher snakes (*Pituophis melanoleucus*) commonly hunt lizards and small mammals in grasslands.

Resident grassland birds of project area include the Western Meadowlark (*Sturnella neglecta*), Mourning Dove (*Zenaida macroura*), and Horned Larks (*Eremophila alpestris*). In the winter these species are joined by American Pipits (*Anthus rubescens*) and Savannah Sparrows (*Passerculus sandwichensis*) among others. Raptors, which nest and roost in adjacent riparian habitats, hunt here. These include Black-shouldered Kites (*Elanus caeruleus*), Red-tailed Hawks (*Buteo jamaicensis*), Golden Eagles (*Aquila chrysaetos*), American Kestrels (*Falco sparverius*), Barn Owls (*Tyto alba*), and Great Horned Owls (*Bubo virginianus*).

Large populations of small mammals provide a primary source of prey for many predators. The most obvious small mammal, the California ground squirrel (*Spermophilus beecheyi*), occurs in numerous scattered colonies. Grasslands also provide an abundant food supply for small mammals such as the deer mouse (*Peromyscus maniculatus*) and Botta's pocket gopher (*Thomomys bottae*). In turn, these small mammals serve as prey for coyotes (*Canis latrans*), red foxes (*Vulpes vulpes*), badgers (*Taxidea taxus*), and avian predators.

Blue oak woodlands occupy low elevation foothills bordering the Central Valley. Stands are highly variable, ranging in density from open savanna with grassy understories at low elevations to closed forest at higher elevations. The majority of the shoreline around the reservoirs support an open woodland of blue oaks (*Quercus douglasii*). Although the blue oak is the dominant tree of this habitat, foothill pine (*Pinus sabiniana*), interior live oak (*Quercus wislizenii*), and California buckeye (*Aesculus californica*) are occasionally found here. Trees are sufficiently well spaced such that canopy closure is uncommon. Shrubs, such as poison oak (*Toxicodendron diversilobum*), Mariposa manzanita (*Arctostaphylos mariposa*), coffeeberry (*Rhamnus californica*), and gooseberry (*Ribes quercetorum*) are uncommon. Instead, the understory consists of non-native annual grasses and associated forbs typical of annual grassland.

Wildlife use of blue oak woodland habitats is, in many ways, similar to that of annual grassland. Oak trees, however, provide cover, breeding and foraging habitat for a number of additional species. Acorn Woodpecker (*Melenerpes formicivorous*), Western Scrub-Jay (*Aphelocoma Californica*), Lark Sparrow (*Chondestes grammacus*), Plain Titmouse (*Parus inornatus*), and California Quail (*Callipepla californica*) are common resident species. Resident mule deer (*Odocoileus hemionus*), bobcats (*Lynx rufus*), and mountain lions (*Felis concolor*) occur throughout this habitat.

Though the reservoirs are all human-made, they support several important wildlife resources. Millerton Lake has been well documented as an important wintering area for Bald Eagles (Suydam and Conrad 1985, Rhodehamel 1991). In spring 1993, a pair of Bald Eagles bred at Eastman Lake. In winter, Millerton Lake is the roosting area for a large number of gulls (*Larus spp.*) that forage throughout central Fresno and Madera Counties. Additionally, the large open water areas provide foraging and loafing areas for species such as wintering waterfowl and the American Coot (*Fulica americana*). A list of special-status species that would be expected to occur at these three reservoirs is provided (Table BR-1).

**Table BR-1**
**Special Status Species Observed or Expected in the Vicinity of Eastman, Hensley, and Millerton Lakes**

| Common Name | Scientific Name | Federal Status | State Status |
|---|---|---|---|
| Hartweg's Golden Sunburst | *Pseudobahia bahiifolia* | E | E |
| Valley Longhorn Elderberry Beetle | *Desmocerus californicus dimorphous* | T | None |
| California Tiger Salamander | *Ambystoma californiense* | FC | SC |
| Western Spadefoot | *Scaphiopus hammondi* | None | SC |
| Foothill Yellow-legged Frog | *Rana boylii* | None | SC |
| Western Pond Turtle | *Clemmys marmorata* | None | SC |
| California Horned Lizard | *Phrynosoma coronatum frontale* | None | SC |

**Table BR-1**
**Special Status Species Observed or Expected in the Vicinity of Eastman, Hensley, and Millerton Lakes**

| Common Name | Scientific Name | Federal Status | State Status |
|---|---|---|---|
| San Joaquin Coachwhip | *Masticophis flagellum ruddocki* | None | SC |
| American White Pelican | *Pelecanus erythrorhynchos* | None | SC |
| Double-crested Cormorant | *Phalacrocorax auritus* | None | SC |
| Osprey Pandion | *Pandion haliaetus* | None | SC |
| Bald Eagle | *Haliaetus leucocephalus* | FPD | E |
| Northern Harrier | *Circus cyaneus* | None | SC |
| Sharp-shinned Hawk | *Accipiter striatus* | None | SC |
| Cooper’s Hawk | *Accipiter cooperi* | None | SC |
| Ferruginous Hawk | *Buteo regalis* | None | SC |
| Golden Eagle | *Aquila chrysaetos* | None | SC |
| Merlin | *Falco columbarius* | None | SC |
| Peregrine Falcon | *Falco peregrinus* | Delisted | E |
| Prairie Falcon | *Falco mexicanus* | None | SC |
| California Gull | *Larus californicus* | None | SC |
| Burrowing Owl | *Athene cunicularia* | None | SC |
| Long-eared Owl | *Asio otus* | None | SC |
| Loggerhead Shrike | *Lanius ludovicianus* | None | SC |
| California Horned Lark | *Eremophila alpestris actia* | None | SC |
| Yellow Warbler | *Dendroica petechia* | None | SC |
| Spotted Bat | *Euderma maculatum* | None | SC |
| Townsend’ Big-eared Bat | *Corynorhinus towndendii* | None | SC |
| Pallid Bat | *Antrozous pallidus* | None | SC |
| Western Mastiff Bat | *Eumops perotis* | None | SC |

Note:
E Endangered    T Threatened
FC Candidate Species    FPD Proposed for Delisting
SC Species of special concern.

### *San Joaquin River*

The best riparian habitat along the San Joaquin River now occurs in scattered locations below Friant Dam downstream to Firebaugh. Open stands of large valley oaks (*Quercus lobata*) and western sycamores (*Platanus racemosa*) occur on the river's flood plain. Associated species frequently include Oregon ash (*Fraxinus latifolia*), Fremont’s cottonwood (*Populus fremontii*), and red willow (*Salix laevigata*). Other species found on channel banks may include white alder (*Alnus rhombifolia*), Goodding's Willow (*Salix gooddingii*), and common buttonbush (*Cephalanthus occidentalis*). More typical of the river's riparian habitat beyond Firebaugh are dense stands of sandbar willow (*Salix hindsiana*), scattered groves of Fremont's cottonwoods, and mixed stands of Goodding's and red willows. Here, this vegetation is confined to a relatively narrow band along the river channel, as leveled agricultural fields now abut flood control levees along the river.

Small pockets of fresh emergent wetland habitat are present in shallow waters of the San Joaquin River. It is characterized by emergent hydrophytic (water-loving) vegetation rooted in water less than 2 feet deep. Plants typical of this habitat include cattail (*Typha sp.*), California bulrush (*Scirpus californicus*), three square (*Scirpus americanus*), umbrella sedge (*Cyperus eragrostis*), creeping spikerush (*Eleocharis sp.*), and Baltic rush (Juncus balticus).

Reptiles and amphibians are common to riparian habitats. The leaf litter and fallen branches from the big trees provide cover for amphibians such as black-bellied slender salamander (*Batrachoceps nigriventris*), western toad (*Bufo boreas*), and pacific treefrog (*Hyla regilla*). Several lizards can also be found here including western fence lizard, Gilbert's skink, and southern alligator lizard (*Gerrhonotus multicarinatus*). Snakes expected to be found here include the Racer (*Coluber constrictor*) and the common kingsnake (*Lampropeltis getulus*). Riparian habitats probably provide nesting habitat for western pond turtles (*Clemmys marmorata*).

The dense vegetation and many canopy layers attract a large number of avian species to riparian habitats. Both Red-shouldered Hawks (*Buteo lineatus*) and Great Horned Owls hunt and roost here. Nuttall's Woodpecker (*Picoides nutallii*) and Northern Flicker (*Colaptes auratus*) excavate nest holes in trees. Nest holes abandoned by woodpeckers are used by Western Screech Owls (*Otus kennicottii*), Ash-throated Flycatchers (*Myiarchus cinerascens*), and other cavity nesters. Other songbirds found in this habitat include Song Sparrow (Melospiza melodia), Northern Oriole (Icterus galbula), and Bewick's Wren (*Thryomanes bewckii*). A large rookery exists on Rank Island a few miles down stream from the Friant Dam. This rookery provides nesting trees for the Great Blue Heron (*Ardea herodias*), Great Egret (*Ardea alba*), and Snowy Egret (*Egretta thula*). The California Department of Fish and Game considers Rank Island a sensitive area for wildlife.

Mammals such as beaver (*Castor canadensis*) and striped skunk (*Mephitis mephitis*) are well represented in valley foothill riparian forest. Small mammals occurring in tall grass or brushy thickets include the Audubon's cottontail (*Sylvilagus audubonii*). Predators such as coyote and long-tailed weasel (*Mustela frenata*) are attracted to wooded riparian habitats by an abundance of prey. Mule deer (*Odocoileus hemionus*) and occasional mountain lions (*Felis concolor*) move down from Little Table Mountain into the riparian habitats of the San Joaquin River. A list of special-status species that would be expected to occur along the San Joaquin River riparian zone are presented in Table BR-2.

**Table BR-2**
**Special Status Species Observed or Expected in the San Joaquin River Area**

| Common Name | Scientific Name | Federal Status | State Status |
|---|---|---|---|
| Valley Longhorn Elderberry Beetle | *Desmocerus californicus dimorphus* | T | None |
| Western Pond Turtle | *Clemmys marmorata* | None | SC |
| California Horned Lizard | *Phyranosoma coranatum frontale* | None | SC |
| San Joaquin Coachwhip | *Masticophis flagellum ruddocki* | None | SC |
| American White Pelican | *Pelecanus erythrorhynchos* | None | SC |
| Double-crested Cormorant | *Phalacrocorax auritus* | None | SC |
| Osprey | *Pandion haliateus* | None | SC |
| Bald Eagle | *Haliaeetus leucocephalus* | FPD | E |
| Northern Harrier | *Circus cyaneus* | None | SC |
| Sharp-shinned Hawk | *Accipiter striatus* | None | SC |
| Cooper’s Hawk | *Accipiter cooperi* | None | SC |
| Swainson’s Hawk | *Buteo swainsoni* | None | T |

**Table BR-2**
**Special Status Species Observed or Expected in the San Joaquin River Area**

| Common Name | Scientific Name | Federal Status | State Status |
|---|---|---|---|
| Ferruginous Hawk | *Buteo regalis* | None | SC |
| Golden Eagle | *Aquila chrysaetos* | None | SC |
| Merlin | *Falco columbarius* | None | SC |
| Peregrine Falcon | *Falco peregrinus* | Delisted | E |
| Prairie Falcon | *Falco mexicanus* | None | SC |
| California Gull | *Larus californicus* | None | SC |
| Burrowing Owl | *Athene cunicularia* | None | SC |
| Long-eared Owl | *Asio otus* | None | SC |
| Loggerhead Shrike | *Lanius ludovicianus* | None | SC |
| California Horned Lark | *Eremophila alpestris actia* | None | SC |
| Yellow Warbler | *Dendroica petechia* | None | SC |
| Tricolored Blackbird | *Agelaius tricolor* | None | SC |
| Townsend' Big-eared Bat | *Corynorhinus towndendii* | None | SC |
| Pallid Bat | *Antrozous pallidus* | None | SC |
| Western Mastiff Bat | *Eumops perotis* | None | SC |

Note:

| | | | | | |
|---|---|---|---|---|---|
| E | Endangered | FC | Candidate Species | SC | Species of special concern |
| T | Threatened | FPD | Proposed for Delisting | | |

***Fresno River and Chowchilla River***

During most years, the Fresno and Chowchilla Rivers are dry during the summer months, therefore they support less extensive riparian habitats than the San Joaquin River. The primary habitats that occur in these river channels are riparian woodland, riparian scrub, annual grassland, and, to a smaller degree, emergent wetland.

Dense riparian woodland can be found immediately below Hensley Lake on the Fresno River. Fremont's cottonwoods, red willows, sandbar willows, and Goodding's willows are species typically found within the river's bed and banks. Trees of the upper bank are largely restricted to valley oaks. Much of the former Fresno River flood plain still supports an open woodland of valley oaks and Fremont's cottonwoods, with red willows well established in low-flow meander channels.

With the exception of a one-mile stretch immediately below Buchanan Dam, riparian vegetation is very sparse or absent along the former bed of the Chowchilla River. Riparian vegetation below the dam consists primarily of Fremont's cottonwoods and red and sandbar willows. The lack of flows in the Chowchilla River probably preclude the re-establishment of native riparian vegetation along its banks.

Wildlife species frequently encountered in these two river channels include Black Phoebe (*Sayornis nigricans*), Yellow-billed Magpie (*Pica nutalli*), Brewer's Blackbird's (*Euphagus cyanocephalus*), Virginia opossum (*Didelphis virginiana*), and striped skunk. A list of special-status species that would be expected to occur along the Fresno and Chowchilla River riparian zones are presented in Table BR-3.

***Madera Canal***

The Madera Canal right-of-way is not considered high quality habitat due to routine maintenance, traffic, and weed and pest control. For most of it's length, the concrete-lined sections of the canal do not allow vegetation to become established within the canal. However, some sections of the right-of-way are unlined and although not considered to be high quality, fairy shrimp, salamanders and spadefoot toads are known to occur there. Reclamation is working in coordination with the water authorities, the Service, and the California Department and Fish and Game to improve habitat along the canal right-of-way where appropriate. The purpose is to facilitate species recovery and implement recovery actions that are within Reclamation's area of responsibility. Coordination with water authorities and the agencies assures that there will be no conflict with ongoing operation and maintenance of the canal or other facilities.

***Friant-Kern Canal***

The Friant-Kern Canal right-of-way is not considered high quality habitat due to routine maintenance, traffic, weed and pest control. For the most part, the canal is concrete-lined and does not allow vegetation to become established. Several sections are unlined however, providing marginal habitat value. The right-of-way may also be used as a travel corridor for the San Joaquin kit fox. When considered along with other adjacent habitat areas, including other lands owned by the Bureau, its potential value as a travel corridor is enhanced.

Reclamation is working in coordination with the water authorities, the Service, and the California Department and Fish and Game to improve habitat along the canal right-of-way where appropriate. The purpose is to facilitate species recovery and implement recovery actions that are within Reclamation's area of responsibility. Coordination with water authorities and the agencies assures that there will be no conflict with ongoing operation and maintenance of the canal or other facilities (Appendix B).

**Table BR-3**
**Special Status Species Observed or Expected in the Fresno River and Chowchilla River Areas**

| Common Name | Scientific Name | Federal Status | State Status |
|---|---|---|---|
| Western Pond Turtle | *Clemmys marmorata* | None | SC |
| California Horned Lizard | *Phyranosoma coranatum frontale* | None | SC |
| San Joaquin Coachwhip | *Masticophis flagellum ruddocki* | None | SC |
| Double-crested Cormorant | *Phalacrocorax auritus* | None | SC |
| Bald Eagle | *Haliaeetus leucocephalus* | FPD | E |
| Northern Harrier | *Circus cyaneus* | None | SC |
| Sharp-shinned Hawk | *Accipiter striatus* | None | SC |
| Cooper's Hawk | *Accipiter cooperi* | None | SC |
| Ferruginous Hawk | *Buteo regalis* | None | SC |
| Golden Eagle | *Aquila chrysaetos* | None | SC |
| Merlin | *Falco columbarius* | None | SC |
| Peregrine Falcon | *Falco peregrinus* | Delisted | E |
| Prairie Falcon | *Falco mexicanus* | None | SC |
| Long-billed Curlew | *Numenius americanus* | None | SC |
| California Gull | *Larus californicus* | None | SC |
| Burrowing Owl | *Athene cunicularia* | None | SC |
| Long-eared Owl | *Asio otus* | None | SC |
| Short-eared Owl | *Asio falmmeus* | None | SC |
| Loggerhead Shrike | *Lanius ludovicianus* | None | SC |
| California Horned Lark | *Eremophila alpestris actia* | None | SC |
| Yellow Warbler | *Dendroica petechia* | None | SC |
| Tricolored Blackbird | *Agelaius tricolor* | None | SC |
| Pallid Bat | *Antrozous pallidus* | None | SC |

Note:
E Endangered
T Threatened
FC Candidate Species
FPD Proposed for Delisting
SC Species of special concern

### *Contract Service Area*

Major land uses within the Friant Division contract service area include natural or native habitats (56,307 acres), agriculture (901,568 acres), and urban areas (61,365) (Table BR-4). Major natural areas include grasslands (native and nonnative), oak woodlands, riparian areas, and freshwater aquatic communities (seasonal wetlands, vernal pools, and lakes) (Holland 1986, Mayer and Laudenslayer 1988, and Holland and Keil 1989, 1995, Hickman 1993). Tables BR-5 and BR-6 lists those special-status species most likely to occur within the Friant Division contract service area. Agricultural areas include row crops, vineyards, orchards, grains, cotton, pastures, and dairies.

**Table BR-4**
**Summary of CVP Friant Division Land Use or Habitat Types**

| | Habitat Type (acres) | | |
|---|---|---|---|
| **Contractor** | **Agriculture[a]** | **Natural or Native[b]** | **Urban** |
| Arvin-Edison WSD[c] | 116116 | 13734 | 5156 |
| Chowcilla WD[d] | 59721 | 3001 | 2778 |
| Delano-Earlimart ID[ce] | 53779 | 1245 | 1374 |
| Exeter ID[e] | 11938 | 13 | 489 |
| Fresno ID[f] | 156954 | 8572 | 25576 |
| Garfield WD[f] | 1357 | 249 | 198 |
| Gravelly Ford WD[d] | 7920 | 496 | 8 |
| International WD[f] | 677 | 54 | 0 |
| Ivanhoe ID[e] | 10634 | 249 | 61 |
| Lewis Creek WD[e] | 195 | 55 | 47 |
| Lindmore ID[e] | 25753 | 576 | 605 |
| City of Lindsay[e] | 347 | 22 | 1176 |
| Lindsay-Strathmore ID[e] | 13200 | 1601 | 924 |
| Lower Tule River ID[e] | 93502 | 7671 | 1917 |
| Madera ID[d] | 114672 | 6443 | 9423 |
| City of Orange Cove[f] | 73 | 24 | 672 |
| Orange Cove ID[ef] | 27531 | 1474 | 238 |
| Porterville ID[e] | 14651 | 900 | 543 |
| Saucelito ID[e] | 19342 | 321 | 103 |
| Shafter-Wasco ID[c] | 34728 | 792 | 2801 |
| Southern San Joaquin MUD[c] | 51735 | 5619 | 3923 |
| Stone Corral ID[e] | 6321 | 499 | 20 |
| Tea Pot Dome WD[e] | 3365 | 20 | 58 |
| Terra Bella ID[e] | 11277 | 1274 | 1279 |
| Tulare ID[e] | 65780 | 1403 | 1996 |
| **Total** | **901568** | **56307** | **61365** |

Source: David Scroggs, pers. comm., CDWR, Fresno, CA 1999

[a] Includes irrigated and non-irrigated lands.
[b] Includes wetland and riparian habitats.
[c] 1990 Kern County data.
[d] 1995 Madera County data.
[e] 1993 Tulare County data.
[f] 1994 Fresno County data.

**Table BR-5**
**Special Status Species Observed or Expected in the Friant Division Contract Service Area**

| Common Name | Scientific Name | Federal Status | State Status |
|---|---|---|---|
| **Plants** | | | |
| Hoover's Woollystar | *Eriastrum hooveri* | T | None |
| Bakersfield Cactus | *Opuntia basilaris var. treleasei* | E | E |
| San Joaquin Woollythreads | *Lembertia congdonii* | E | None |
| California Jewelflower | *Caulanthus californicus* | E | E |
| Kern Mallow | *Eremalche kernensis* | E | None |
| Palmate-bracted Bird's Beak | *Cordylanthus palmatus* | E | E |
| Greene's Orcutt Grass | *Tuctoria greenei* | E | None |
| Hartweg's Golden Sunburst | *Pseudobahia bahiifolia* | E | E |
| Hairy Orcutt Grass | *Orcuttia pilosa* | E | E |
| Hoover's Spurge | *Chamaesyce hooveri* | T | None |
| Succulent Owl's-clover | *Castilleja campestris ssp. succlenta* | T | E |
| Boggs Lake Hedge-Hyssop | *Gratiola heterosepala* | None | E |
| **Invertebrates** | | | |
| Vernal Pool Fairy Shrimp | *Branchinecta lynchi* | T | None |
| Vernal Pool Tadpole Shrimp | *Lepidurus packardi* | E | None |
| Valley Longhorn Elderberry Beetle | *Desmocerus californicus dimorphus* | T | None |
| **Threatened or Endangered Animals** | | | |
| Blunt-nosed Leopard Lizard | *Gambelia silus* | E | E |
| Giant Garter Snake | *Thamnophis gigas* | T | T |
| California Condor | *Gymnogyps californianus* | E | E |
| Bald Eagle | *Haliaeetus leucocephalus* | FPD | E |
| Swainson's Hawk | *Buteo swainsoni* | None | T |
| American Peregrine Falcon | *Falco peregrinus anatum* | Delisted | E |
| Least Bell's Vireo | *Vireo bellii pusillus* | E | E |
| Fresno Kangaroo Rat | *Dipodomys nitratoides exilis* | E | E |
| Tipton Kangaroo Rat | *Dipodomys nitratoides nitratoides* | E | E |
| San Joaquin Kit Fox | *Vulpes macrotis mutica* | E | T |
| **Species of Concern** | | | |
| California Tiger Salamander | *Ambystoma californiense* | FC | SC |
| Western Spadefoot | *Scaphiopus hammondi* | None | SC |
| Western Pond Turtle | *Clemmys marmorata* | None | SC |
| California Horned Lizard | *Phrynosoma coronatum frontale* | None | SC |
| California Legless Lizard | *Anniella pulchra* | None | SC |
| San Joaquin Coachwhip | *Masticophis flagellum ruddocki* | None | SC |
| American White Pelican | *Pelecanus erythrorhynchos* | None | SC |
| Double-crested Cormorant | *Phalacrocorax auritus* | None | SC |
| White-faced Ibis | *Plegadis chihi* | None | SC |
| Osprey | *Pandion haliaetus* | None | SC |
| Northern Harrier | *Circus cyaneus* | None | SC |
| Sharp-shinned hawk | *Accipiter striatus* | None | SC |

**Table BR-5**
**Special Status Species Observed or Expected in the Friant Division Contract Service Area**

| Common Name | Scientific Name | Federal Status | State Status |
|---|---|---|---|
| Cooper's Hawk | *Accipiter cooperii* | None | SC |
| Ferruginous Hawk | *Buteo regalis* | None | SC |
| Golden Eagle | *Aquila chrysaetos* | None | SC |
| Merlin | *Falco columbarius* | None | SC |
| Prairie Falcon | *Falco mexicanus* | None | SC |
| Western Snowy Plover | *Charadrius alexandrinus nivosus* | None | SC |
| Mountain Plover | *Charadrius montanus* | FC | SC |
| Long-billed Curlew | *Numenius americanus* | None | SC |
| California Gull | *Larus californicus* | None | SC |
| Burrowing Owl | *Athene cunicularia* | None | SC |
| Long-eared Owl | *Asio otus* | None | SC |
| Short-eared owl | *Asio flammeus* | None | SC |
| Loggerhead Shrike | *Lanius ludovicianus* | None | SC |
| California Horned Lark | *Eremophila alpestris actia* | None | SC |
| Yellow Warbler | *Dendroica petechia* | None | SC |
| Yellow-breasted Chat | *Icteria virens* | None | SC |
| Tricolored Blackbird | *Agelaius tricolor* | None | SC |
| Townsend's Big-eared Bat | *Corynorhinus townsendii* | None | SC |
| Pallid Bat | *Antrozous pallidus* | None | SC |
| Tulare Grasshopper Mouse | *Onychomys torridus ramona tularensis* | None | SC |

Note:
E Endangered
T Threatened
FC Candidate Species
FPD Proposed for Delisting
SC Species of special concern

**Table BR-6**
**Vascular Plants Listed as Rare or Endangered by the California Native Plant Society That Have Been Observed or Expected to Occur in the Friant Division Contract Service Area**

| Common Name | Scientific Name | CNPS List |
|---|---|---|
| Brittlescale | *Atriplex depressa* | 1B |
| Coulter's Goldfields | *Lasthenia glabrata ssp. coulteri* | 1B |
| Hoover's calycadenia | *Calycadenia hoovii* | 1B |
| Heartscale | *Atriplex cordulata* | 1B |
| Hispid Bird's-beak | *Cordylanthus mollis ssp. hispidus* | 1B |
| Jared's Pepper-grass | *Lepidium jaredii ssp. jaredii* | 1B |
| Lesser Saltscale | *Atriplex minuscula* | 1B |
| Lost Hills Crownscale | *Atriplex vallicola* | 1B |
| Munz's Tidy-tips | *Layia munzii* | 1B |
| Panoche Pepper-grass | *Lepidium jaredii ssp. album`* | 1B |
| Recurved Larkspur | *Delphinium recurvatum* | 1B |
| Sanford's Arrowhead | *Sagittaria sanfordii* | 1B |
| Slough Thistle | *Cirsium crassicaule* | 1B |
| Spiney-sepaled Button Celery | *Eryngium spinosepalum* | 1B |
| Stinkbells | *Fritillaria agrestis* | 4 |
| Tree Anemone | *Carpenteria californica* | 1B |

Note:
Vascular plants listed as rare or endangered by the California Native Plant Society (Skinner and Pavlik 1994), but which have no designated status under state endangered species legislation, are defined as follows:

- List 1B. Plants rare, threatened, or endangered in California and elsewhere.
- List 2. Plants rare, threatened, or endangered in California, but more numerous elsewhere.
- List 3. Plants about which we need more information - A review list.
- List 4. Plants of limited distribution - A watch list.

### *Habitats Within the Friant Division Contract Service Area*

***Valley Grassland Community*.** Grassland communities within the natural areas of the Friant Division can be divided into non-native grasslands and relic native communities. Non-native Grassland is the most wide-spread and intermingles with remnant native communities of all types. It is dominated by non-native, annual grass species such as wild oats, ripgut brome, soft chess, red foxtail chess (*Bromus madritensis rubens*), foxtail (*Hordeum murinum*), wild rye (*Lolium multiflorum*), and annual fescues (*Vulpia sp.*). The most common non-native forbs include mustard (*Brassica sp.)* and filaree (*Erodium sp.*).

Relic native communities include Valley Needlegrass Grassland, Valley Sacaton Grassland, Valley Wildrye Grassland, and Wildflower fields. Valley Needlegrass Grassland typically occurs on fine-textured soils in openings in oak savanna. Once dominated by perennial bunch grasses such as purple needlegrass (*Nassella pulchra*) and slender needle grass (*N. lepida*), most remnants are dominated by introduced annual species. Valley Sacaton Grasslands occur on poorly drained, alkaline soils. Dominant species include perennial, bunch grass alkali sacaton (*Sporobolus airoides*), and salt grass (*Distichlis spicata*). Valley Wild Rye Grassland occurs on moist sites at low elevations often in openings in riparian forest habitats. Soils are typically subalkaline and experience seasonal flooding. The sod-forming perennial grass leymus (*Leymus triticoides*) dominates. Remnant wildflower fields are dominated by non-native annual grass species and are characterized by brilliant displays of spring-blooming forbs such as California poppy (*Eschscholzia californica*), lupine (*Lupinus sp*), trefoil, rusty popcornflower, and layia (*Layia sp.*). Other common native forbs include fiddleneck (*Amsinckia sp*.), gilia (*Gilia sp*.), goldfields (*Lasthenia californica*), linanthus (*Linanthus sp.*), owl's clover (*Orthocarpus spp*.), and phacelia (*Phacelia spp*.). These are all spring flowering plants and most are annuals. Common summer and fall flowering plants include tarweeds (*Lagophylla spp*.), turkey mullein, vinegar weed, and buckwheat (*Eriogonum spp*.). Annual native grass species include wild barley (*Hordeum depressum*). Some of the grassland areas also have vernal pools present which have their own unique characteristics (see vernal pool description below).

Grasslands provide cover and foraging areas for species mentioned in the previous discussions of grasslands adjoining reservoirs section, as well as for species like, the black-tailed hare, western harvest mouse (*Reithrodontomys megalotis*), California vole (*Microtus californicus*), and the Endangered San Joaquin kit fox (*Vulpes macrotis mutica*). These areas provide nesting areas for the Barn Owl, Burrowing Owl, Short-eared Owl, Horned Lark, Western Kingbird, Savannah Sparrow, and Western Meadowlark. This habitat provides important foraging areas for the Turkey Vulture, Northern Harrier, American Kestrel, White-tail Kite, and Prairie Falcon. Reptilian species include the western fence lizard, common garter snake, California horned lizard (*Phrynosoma coronatum frontale*), western rattlesnake (*Crotalus viridis*) and the endangered blunt-nosed leopard lizard (*Gambelia silus*).

***Oak Woodland Communities*.** Oak woodlands occur at elevations ranging from 30 to 5,000 feet in the foothills of the Sierra Mountain and San Joaquin Valley. Dominant species and community structure are influenced by elevation, soils, and aspect. These woodlands are dominated by trees that are 15 to 70 feet in height and vary from open savannas to dense, closed-canopy communities. The most common type consists of scattered trees and scrubs with an understory of grasses and forbs. Oak woodland areas are often more dense on the north-facing slopes compared to the south-facing slopes. At higher elevations, oak woodlands are often more dense and have a greater species diversity compared to lower levels. The understory of an oak woodland includes grasses and forbs previously described above and shrubs such as California buckeye and redbud (*Cercis occidentalis)*. There are two groups of Oak Woodland Communities in the San Joaquin Valley region; 1) Valley Oak Woodland Communities and 2) Foothill Woodland Communities. Valley Oak Woodland is the predominant type that exists within the Friant Division contract service area.

Valley Oak Communities. Valley Oak Woodlands mix into foothill woodlands, but are generally restricted to deep alluvial valley soils at low elevations which parallel riparian communities. Other oak species tend to occur on shallower soils on slopes. Valley oak stand densities range from open savanna to dense forest savanna and valley oak is often the only canopy species. The understory is typically composed of non-native grasses and forbs as described above. Most of the valley oaks in the San Joaquin Valley have been removed for cultivation and urbanization. A few scattered stands remain in the valley in areas around dwellings and in parks. Unfortunately very little regeneration has occurred, primarily due to livestock grazing.

Valley oak woodlands provide important food and cover for many species of wildlife. Oak trees are used for foraging, shelter, nesting, and loafing by a variety of avian and mammalian species. Avian species that would be expected in a valley oak community include the Red-shouldered Hawk, Red-tailed Hawk, California Quail, Plain Titmouse, Western Scrub-jay, Spotted (or *Rufous-sided*) Towhee (*Pipilo maculatus*), Bewick's Wren, Bushtit (*Psaltriparus minimus*), and Acorn Woodpecker. Mammalian species include the mule deer, western gray squirrel (*Sciurus griseus*), bobcat, coyote, western harvest mouse, Botta's pocket gopher, California vole, and deer mouse. Reptilian species include the western fence lizard, common garter snake, and western rattlesnake.

***<u>Riparian Communities</u>*.** Riparian Communities occur along the Tule River and numerous creeks and sloughs within the Friant Division service contract area. Riparian communities usually consist of one or more deciduous tree species plus an assortment of shrubs and herbs that border streams, rivers, lakes, and springs. Trees vary from tall, dense forests to a scattering of a few individual trees. The extent of riparian vegetation also varies depending on the size and nature of the banks and floodplains, by the amount of water carried by the waterway, and the depth of the aquifers. The existence of a riparian community is dependent upon a permanent water supply. The microenvironment varies depending on seasonal fluctuation of light availability to the understory. During the winter, deciduous trees are dormant and leafless, allowing direct sunlight to the reach understory vegetation. Some of the herbaceous plants and shrubs grow and flower with the addition of sunlight. During the summer, broadleaf deciduous trees can provide dense shade, resulting in decreased sunlight, which provides for cooler temperatures and higher humidities within the riparian corridor.

Valley and Foothill Riparian Communities. Valley and Foothill Riparian Communities occur from the Central Valley floor to the lower elevation margins of the montane coniferous forest of cismontane California. These riparian zones can vary from broad valley flood plain forests to narrow, steep canyon streams. The dominant trees or shrubs include: white alder, Oregon ash, western sycamore, Fremont's cottonwood, valley oak, red willow, Gooding's (or black) willow, and arroyo willow (*Salix lasiolepis*). Common evergreens include interior live oak, California bay-laurel (*Umbellularia californica*), and a noxious exotic weed, salt cedar or Tamarisk. Common shrubs include: seep willow (*Baccharis salicifolia*), button-willow (*Cephalanthus occidentalis*), dogwoods (*Cornus spp*.), California wild rose (*Rosa californica*), blackberries (*Rubus spp*.), elderberries (*Sambucus spp*.), California grape (*Vitis californica*), and poison oak. Herbaceous species include: spikenard (*Aralia californica*), mugwort (*Artemisia douglasiana*), sedges (*Carex spp*.), flat-sedges (*Cyperus spp*.), spike-rushes (*Eleocharis spp*.), willow-herbs (*Epilobium spp*.), horsetails (*Equisetum spp*.), rushes (*Juncus spp*.), monkeyflowers (*Mimulus spp*.), watercress (*Nasturtium officinale*), bulrushes (*Scirpus spp*.), stinging nettle (*Urtica holosericea*), and cattail. Below is a brief description of the specific riparian communities that potentially could occur within the Friant Division contract service area.

Great Valley Willow Scrub occupies frequently inundated floodplains and banks of major rivers and smaller streams. It is characterized by dense, shrubby thickets dominated by willow species including narrow-leaved willow (*Salix exigua*), arroyo willow, red willow, and dusky willow (*S. melanopsis*) Associated species include California wild rose and Fremont's cottonwood.

Great Valley Cottonwood Riparian Forest occurs in alluvial soils near streams that provide subsurface irrigation year-round. These sites are subject to spring inundation. Characteristic species include Fremont's cottonwood, assorted willows, box elder (*Acer negundo*), and Oregon ash.

White Alder Riparian Forest occurs along rapidly flowing, well aerated, perennial, canyon streams that experience substantial scouring and high flows during spring runoff. Canyons are typically deeply incised, resulting in a narrow riparian corridor.

Great Valley Mixed Riparian Forest occurs further back from river and stream banks, where flooding and scouring events are less frequent and severe. Dominant species are typically winter deciduous and include California walnut (Juglans hindsii), white alder, western sycamore, Fremont's cottonwood, box elder, and assorted willow species.

Great Valley Oak Riparian also occurs further back from river and stream banks, where less physical disturbance occurs during flooding. Dominant species are include valley oak, California walnut, white alder, western sycamore, Oregon ash, blackberries, and poison oak.

Valley and Foothill Riparian Communities provide food, cover, water, migration and movement corridors, escape, nesting, and thermal cover for a wide diversity of wildlife species. Expected wildlife species would be similar to species previously described in the Oak Woodland and Valley Grassland Communities, and the San Joaquin River. Additional species include water dependent species such as the Wood Duck (Aix sponsa), Mallard (Anas platyrhynchos), Great Blue Heron, Great Egret, Snowy Egret, and beaver.

***Freshwater Aquatic Communities*.** Freshwater aquatic communities occur in still and flowing waters and can range in size from small pools to large reservoirs and lakes throughout the Friant Division service contract area. Areas that are seasonally wet also support freshwater aquatic environments. Aquatic communities vary and are dependent on several interacting environmental factors, including species composition, water depths, water level fluctuations, water flow rates, water and air temperatures, other climatic variables, pH, dissolved salts, organic content of the water, nature and depth of bottom sediments, and history of the water body. Deep, open water areas support submergent or floating aquatic plant communities. Shallow water areas generally support emergent vegetation. Seasonal wetlands are temporary and usually become dry during the summer. Water levels in artificial reservoirs (i.e., livestock or farm ponds, irrigation storage ponds) often fluctuate, preventing well-developed aquatic communities from becoming established. Two main types of freshwater aquatic communities are present: (1) limnetic communities which occur in open water (i.e., Lake Woollomes near Delano) and (2) littoral communities which occur in shallow water and along shores of open water bodies. Littoral communities include freshwater marshes, bogs, montane meadows, and vernal pools.

Limnetic Plant Communities. Limnetic plant communities have both algal and higher plant components. The algal component is primarily plankton with a variety of algal species. Vascular plants include hornwort (*Ceratophyllum demersum*), elodea (*Elodea canadensis*), quillwort (*Isoetes spp*.), water-milfoil (*Myriophyllum spp*.), water-nymphs (*Najas spp*.), and pondweeds (*Potamogeton spp*.). Floating plants include water fern (*Azolla filoculoides*), hornwort, duckweed (*Lemna spp*.) water buttercup (*Ranunculus aquatilis*), and bladderwort (*Utricularia spp*.).

Open ponds provide feeding and loafing areas for a variety of birds including the Eared Grebe *(Podiceps nigricollis*), Western Grebe (*Aechmophorus occidentalis*), Clark's Grebe (*A. clarkii*), American White Pelican (*Pelecanus erythrorhynchos*), Double-crested Cormorant (*Phalacrocorax auritus*), American Coot, and waterfowl such as the Canvasback (*Aythya valisineria*), Redhead (*Aythya americana*), Lesser Scaup (*Aythya affinis*), Mallard, Northern Pintail (*Anas acuta*), Northern Shoveler (*Anas clypeata*), and

Canada Goose (*Branta canadensis*). Depending on their location, reservoirs provide a water source for a variety of terrestrial wildlife including coyotes, badgers, striped skunks, weasels, California Quail, and passerine birds.

Freshwater Marsh Communities. Freshwater marsh communities develop in locations with slow-moving or stagnant water. These communities occur along margins of ponds and lakes and in the floodplains of slow moving streams and rivers. Marshes can also develop where seepage from springs or shallow water tables allow rooted aquatic plants to become established. Common marsh plants include sedges (*Carex spp*.), spikerushes, bulrushes, bur reeds (*Sparganium spp*.), cattail, tule (*Scirpus acutus*), water hemlock (*Cicuta maculata*), willow-herbs (*Epilobium spp*.), common monkeyflower (Mimulus guttatus), watercress, smartweeds (*Polygonum spp*.), dock (*Rumex spp*.), pondweed, duckweed, and widgeongrass (*Ruppia spp*.).

Freshwater marshes are among the most productive wildlife habitats in California, providing a diversity of habitats for a wide variety of wildlife species. This habitat provides foraging, loafing, and cover area for species such as the Mallard, Northern Pintail, Gadwall (*Anas strepera*), Green-winged Teal (*Anas crecca*), Cinnamon Teal (*Anas cyanoptera*), Canada Goose, White-fronted Goose (*Anser albifrons*), American Coot, American Bittern (*Botaurus lentiginosus*), Green Heron (*Butorides striatus*), Great Egret, Snowy Egret, Great Blue Heron, Northern Harrier, Red-tailed hawk, dowitcher (Limnodromus sp.), Least Sandpiper (*Calidris minutilla*), Western Sandpiper (*Calidris mauri*), Black-bellied Plover (*Pluvialis squatarola*), Killdeer (*Charadrius vociferus*), Dunlin (*Calidris alpina*), American Avocet (*Recurvirostra americana*), and Black-necked Stilt (*Himantopus mexicanus*). Mammals include the California vole, muskrat (*Ondatra zibethicus*), raccoon (*Procyon lotor*), coyote, striped skunk, and long-tailed weasel. Amphibians and reptiles that depend on or utilize freshwater marshes include the western toad, western spadefoot (*Scaphiopus hammondi*), pacific treefrog, western pond turtle, and gopher snake.

Vernal Pool Communities. Vernal pools are seasonal, shallow, ephemeral water bodies that occupy depressions in grassland and woodland areas. The pools are underlain by an impervious layer of hardpan, claypan, or bedrock covered with a layer of clay or silt, which results in the collection and ponding of water during winter and spring rains. These pools are generally a few centimeters deep and seldom are more than a meter in depth. The pools gradually dry resulting in a series of concentric rings of herbaceous vegetation forming around the pool margins.

Species composition in the pools varies in accordance with chemical and physical properties such as salinity, alkalinity (pH), depth, and duration of the pool. Most species that occur within vernal pools are endemic to California and require seasonal inundation followed by desiccation to complete their life cycles. Relative to other community types, vernal pools still support a high percentage of native vegetative cover. Vernal pools are characterized by herbaceous plants that begin as aquatic plants and make a transition to a dry land environment as the pools dry by late spring and summer. Most vernal pool vegetation is comprised of annual herbs with some deeply rooted rhizome type perennials. Vernal pool plant species include: foxtail, water starwort (*Callitriche spp*.), hairgrass (*Deschampsia danthonioides*), downingia (*Downingia spp*.), rush (*Juncus spp*.), flowering quillwort (*Lilaea scilloides*), meadowfoam (*Limnanthes douglasii*), tricolor monkeyflower (*Mimulus tricolor*), orcuttia (*Orcuttia spp*.), allocarya (*Plagiobothrys spp*.), popcornflower, woollyheads (*Psilocarphus spp*.), quillwort, water-clover fern, white brodiaea (*Brodiaea hyacinthina*), slender spikerush (*Eleocharis acicularis*), and coyote thistle

(*Eryngium spp*.). Vernal pools lack trees or shrubs. The Friant Division contract service area contains several distinct types of vernal pools including Northern Hardpan, Northern Basalt Flow, and Northern Volcanic Mudflow Vernal Pools.

Animal species that are vernal pool dependent include special-status species such as the fairy shrimp (*Branchinecta lynchi*), longhorn fairy shrimp (*Branchinecta longiantenna*), vernal pool tadpole shrimp (*Lepidurus packardi*), California tiger salamander (*Ambystoma californiense*), and western spadefoot. Common invertebrate species would include the California linderiella (*Linderiella occidentalis*). Migrating birds such the Mallard, Cinnamon Teal, Black-necked Stilt, and Greater Yellowlegs feed and loaf in vernal pools during spring migrations. Other avian and mammalian species that would utilize a vernal pool and its surrounding area include species that are listed in the Grassland Community section.

***Anthropogenic Communities and Agricultural Areas*.** Much of San Joaquin Valley's vegetation has been altered by human activities including urbanization, roads and highways, livestock grazing, and agriculture. Communities dominated by introduced plants and established or maintained by human disturbance are referred to as anthropogenic communities. Anthropogenic communities include: (1) agrestal communities, (2) pastoral communities, (3) ruderal communities, (4) plantations, and (5) the urban mix. Agrestal communities occur in areas that have been disturbed by cultivation and thrive in the same environment as agricultural crops. Pastoral communities are dominated by species that are adapted to livestock grazing. Valley grassland communities have become a type of pastoral community. Ruderal communities are highly disturbed areas such as roadsides and similar disturbed sites in towns and cities. Plantations are areas that have been planted with trees such as windbreaks and orchards. Urban mix habitats are areas where nonnative plant species have escaped or been planted in and around urban and residential developments. It is not uncommon to find a mix of native and nonnative plants in urban open areas. The local urban mix is difficult to classify due to the variety and vast number of cultivated species introduced into the urban setting.

Anthropogenic communities provide some wildlife habitat values to native animal species, as well as to non-native species such as the House Sparrow (*Passer domesticus*), European Starling (*Sturnus vulgaris*), Rock Dove (*Columba livia*), black rat (*Rattus rattus*), and house mouse (*Mus musculus*). Wintering waterfowl and coots could be expected to forage on park and golf course lawns. Trees and shrubs provide nesting, roosting, and foraging areas for native species such as the Northern Mockingbird (*Mimus polyglottos*), Mourning Dove, Brewer's Blackbird (*Euphagus cyanocephalus*), American Crow (*Corvus brachyrhynchos*), and Raven (*Corvus corax*), as well as for hummingbirds, and other song birds. Mammals that would be expected in an urban setting include the Virginia opossum, striped skunk, Botta's pocket gopher, ground and tree squirrels, and bats.

Agricultural areas provide cover, foraging, and loafing areas for a variety of wildlife. Pre-irrigated grain fields provide food and loafing areas for migrating and wintering waterfowl, shorebirds, gulls, and terns. Standing grain and alfalfa fields provide feeding, nesting, and escape cover for ducks such as the Mallard, Gadwall, and Cinnamon Teal, and for blackbirds. Grain and alfalfa fields support rodent populations which in turn provide hunting areas for avian and mammalian predators. Irrigated alfalfa fields provide foraging areas for gulls and egrets. Open, fallow fields provide areas for wintering species such as the Mountain Plover (*Charadrius montanus*). Fallow fields with vegetation can provide cover and food for small mammals, which provide hunting areas for avian and terrestrial predators. Orchards provide nesting and roosting areas for species such as Mourning Doves and other passerines, as well as habitat for small mammalian species such as the California ground squirrel.

## Environmental Consequences

### *No Action Alternative*

Under the NAA, all existing Friant Division management will continue to operate under current existing conditions. No significant impacts to vegetation and wildlife are expected, since no additional infrastructure (i.e., dams, increase in dam heights, canals, etc.) will be constructed. Additionally, under this alternative, there will be no increase in deliveries and no conversion of existing natural habitat into farmland.

### *Alternative 1*

Alternative 1 is assumed to have similar effects to the NAA. Therefore, there are no impacts to biological resources under this alternative.

### *Alternative 2*

This Alternative is similar to the NAA and Alternative 1, but additional water costs above Alternative 1 costs could potentially increase the amount of fallowed lands and further decrease affordable water for private wetlands. Primary reasons for the development and maintenance of private wetlands in the region include duck clubs, the economic benefit realized by landowners through Food Securities Act Wetland Reserve Program (administered through the Natural Resources Conservation Service -NRCS), and larger initiatives currently being planned or developed in the region (e.g., Ducks Unlimited's Valley Care Program). Many of these efforts require the allocation and purchase of water to be successful. Increased water costs may create a prohibitive barrier to their continued development.

In addition, the increased costs could reduce the amount of water available to lands that are currently under the Wetland Reserve Program, or other private wetlands such as waterfowl hunting clubs. As the cost of water increases, the opportunity to provide wetland habitat by private landowners generally decreases. This could result in a significant decrease in the availability of wetland habitat in the Friant Division region.

If these fallowed lands are restored to native conditions, they could provide habitat for vegetation and wildlife native to the region. In any event it is not anticipated that any conversion of existing native habitat to agriculture or M&I use would occur from implementing Alternative 1 or 2.

A decrease in some agricultural crops (e.g., alfalfa and grain crops) could potentially impact the amount of nesting and feeding habitat for certain wildlife in the area. Egrets and gulls feed in alfalfa fields during irrigation, cranes and geese feed in these fields during the winter, and other avian species nest in alfalfa. Grain fields provide nesting areas for ducks and blackbirds and feeding areas for a number of wildlife species in the area. While a significant reduction in the amount of alfalfa or grain acreage could impact some species, restoration of these lands to a more natural condition would likely provide benefits to listed and other species considered sensitive.

## Cumulative Effects

***No Action Alternative***

Under this Alternative, all Friant Division management will continue to operate under the current existing conditions. No changes in land use will be created by the project, therefore no cumulative impact on biological resources is anticipated.

***Alternative 1***

Should implementation of this alternative result in some acreage currently in agriculture being fallowed, such fallowing could have a positive effect on sensitive vegetation and wildlife of the region by providing more natural habitat conditions where none currently exist. Hence, no negative cumulative impact on biological resources is anticipated. Cumulative impacts for this Alternative would be similar to those described under the NAA. In general little or no change in current land use will be created through this action. Should implementation of this alternative result in a greater increase in the acreage currently in agriculture being fallowed than under the NAA, such fallowing could have a positive effect on sensitive vegetation and wildlife of the region by providing more natural habitat conditions where none currently exist. Hence, no negative cumulative impact on biological resources is anticipated.

***Alternative 2***

The potential cumulative impacts for the Alternative would be similar to Alternative 1. In other words, there would be no demonstrable contribution to the cumulative impacts.

# RECREATIONAL RESOURCES

## Affected Environment

While recreational boating, camping, picnicking, and sightseeing are water-dependant opportunities within the Friant Division, waterfowl hunting and fishing are the primary water-dependant recreational activity affected by CVP water deliveries. Water from the CVP supports regional hunting and fishing activities by flooding the waterfowl refuges and hunting areas and conveying water through canals that support warm water fishing opportunities. The PEIS has focused on the recreational resources primarily based upon changes in water level at reservoirs and rivers, changes in refuge conditions, and the associated changes in visitor usage. Data were compiled and are presented to characterize recreation conditions at lakes, reservoirs, and rivers in the PEIS. Additionally, the PEIS provides a description of the affected environment including facilities and activities at national wildlife refuges, wildlife management areas, and private hunting clubs in the Friant Division (Reclamation 1999). The Pixley National Wildlife Refuge is the only wildlife refuge within the Friant Division service area.

In 1991, 39 private water fowl hunting clubs were reported for the Tulare Basin Region (i.e., Kern and Tulare counties), totaling approximate 15,700 acres. These hunting clubs flooded approximately 4,800 acres annually with hunting activity estimated at 8,200 hunter days. Flooded acres on water districts used for hunting were estimated to account for 22 percent (1,016 acres) of the total area flooded for water fowl hunting in the Tulare Basin Region. There were no private water fowl hunting clubs reported for Fresno or Madera County which are located in the San Joaquin River Basin (Reclamation 1994a).

Sportfishing in the San Joaquin River Basin was projected at 17.5 million anglers days while Tulare Basin was projected to account for 11.8 million angler days in 1990. Fishing occurs primarily on rivers and lakes on the west slope of the Sierra Nevada and along the California Aqueduct. Most sportfishing that occurs in the CVP canals are for resident warm water species, though no portion of the Friant-Kern and Madera Canals is designated for public access fishing. Fishing in the canals is limited because of the small number of fishes in the canals, access constraints, and the availability of fishing opportunities on nearby reservoirs and rivers (Reclamation 1986).

To expand on the recreational resources presented in the PEIS, the EA focuses on the major and secondary reservoirs within the Division service area. These secondary reservoirs are located in the Hidden and Buchannan Units. The Units are not part of the Friant Division but are located in the Friant service area. Similar to the major reservoirs, secondary reservoirs provide recreational opportunities. However, their smaller size or their proximity to larger or major reservoirs makes them less heavily used for recreational activities. The reservoirs serving the Friant Division are operated by the COE. While the major reservoirs are presented in the PEIS, Millerton Lake is presented in the EA to complete the identification of a CVP reservoir in the Division.

***H.V. Eastman Lake***

H.V. Eastman Lake is located on the Chowchilla River about 15 miles northeast of the City of Chowchilla. This lake is operated by the COE. Structures associated with the lake are comprised of the rock filled Buchanan Dam, five dikes, an ungated spillway section, outlet works, and extensive channel system. With a capacity of 150,600 af, a maximum of 45,000 af is allocated during flood seasons for flood control storage. From Buchanan Dam, water flows to the 30 mile-long Chowchilla Bypass Canal via Ash Slough, the main tributary of Chowchilla River. The Chowchilla and Codorniz Recreation Areas are developed recreational facilities at the lake which support activities, including 62 campsites, group camp areas, picnicking, swimming, hiking, boating activities, and hunting in the wildlife management area.

***Hensley Lake***

Hensley Lake (formerly Hidden Lake) is located on the Fresno River about 15 miles northeast of the City of Madera. This lake is operated by the COE. Structures associated with the lake are comprised of the rolled earthfill Hidden Dam, six dikes, an ungated spillway section, outlet works, and an extensive channel system. With a capacity of 82,500 af, a maximum of 65,000 af is allocated during flood seasons for flood control storage. The Fresno River flows from Hensley Lake to the 13.3 mile-long Madera Canal. Developed recreational facilities at the lake include the Hidden View and Buck Ridge Recreation Areas. These recreational areas provide for 52 campsites, group camping areas, picnicking, swimming, and boating activities. Opportunities are also provided in the 500-acre wildlife area for hiking, bird watching, hunting, mountain biking, and horseback riding.

### *Millerton Lake*

Millerton Lake is located on the San Joaquin River about 25 miles northeast of the city of Fresno and 25 miles east of the city of Madera. Structures associated with the lake are comprised of the 319 foot-high concrete gravity Friant Dam, a 332 foot-wide concrete spillway, 3 drum gate spillways, and an extensive channel system. With a gross storage capacity of 520,500 af, a maximum of 435,000 af is allocated during flood seasons for flood control storage. The Madera and Friant-Kern canals carry water from Millerton Lake to the north and south. Four river outlets divert water into the 152.9 mile-long Friant-Kern Canal flowing south to the Tulare Lake Basin at the southern end of the San Joaquin Valley. The 35.9 mile-long Madera Canal diverts water north from Friant Dam to Madera Irrigation District and Chowchilla Water District.

Millerton Lake State Recreation area is three miles wide at its widest point stretching more than 16 miles up the river canyon, with about 43 miles of shoreline for recreational activities. Facilities provided at the lake include 138 car access campsites, 30 boat access campsites, hundreds of picnic sites, and boating launch ramps. A marina is located on the south shore near the park headquarters. Activities at the lake include swimming, boating, waterskiing , hiking, camping, and horseback riding.

## Environmental Consequences

### *No Action Alternative*

The facilities in the Friant Division would continue to operate in a manner consistent with historic conditions. Lake fluctuation would remain dependent upon the volume of inflow, the volume of water in storage, and the volume of water needed to meet downstream needs. During drier periods or multiple years of prolonged drought, Millerton Lake surface water elevations would be subject to substantial decline as water is released to meet downstream needs and demands.

Recreational activities on the lake are expected to respond according to the water storage volumes, similar to past reservoir elevation patterns. With surface water reductions during drought years, water recreationists would travel greater distances from existing roadways and lake access. However, no recreational uses would be precluded during periods of lake drawdown. These conditions would not change under the NAA.

Existing conditions would not change at Eastman and Hensley Lakes. Recreation opportunities would not change under the NAA. Recreation opportunities on the upper San Joaquin River would not change because no change in operation would occur on Millerton Lake. There would be no changes to the water deliveries to the Pixley National Wildlife Refuge.

***Alternative 1***

Impacts to recreational resources associated with Alternative 1 are assumed to have similar effects as the NAA. No change would occur in the operation of the lakes or water deliveries to the wildlife refuge. Recreation opportunities would not change under Alternative 1 and there are no impacts from this alternative.

***Alternative 2***

The impact to Alternative 2 is similar to the NAA. Reoperation of the Friant Division facilities is not expected as a result of the LTCR conditions. The facilities of the Friant Division would continue to operate in a manner consistent with historic conditions. Lake fluctuation would remain dependent upon the volume of inflow, the volume of water in storage, and the volume of water required to meet downstream needs. Recreation opportunities on the upper San Joaquin River would not change because no change would occur in operations at lakes or water deliveries to the wildlife refuge. The recreational opportunities and uses anticipated under the NAA would also apply to Alternative 2. There is no impact of this alternative on recreational resources in this region.

### Cumulative Effects

Lake flucuations would remain dependent on volume inflow, storage, and downstream needs. Implementation of Alternative 1 or 2 would not contribute to the cumulative impacts to recreational resources from other projects.

## SOCIOECONOMIC RESOURCES

## Affected Environment

The Friant Division of the Central Valley Project (CVP) contributes significantly to the economy of the San Joaquin Valley. Renewal of long-term USBR water service and repayment contracts within the Division is critical to the economy. In conjunction with implementing CVPIA, substantial changes in agricultural production, income, and employment are possible. In addition, economic impacts on agriculture will have a multiplier or induced impact effect on the rest of the regional and statewide economy. In this section, the economic impacts of LTCRs will be evaluated.

The Friant Division’s 28 water districts are located within portions of Fresno, Kern, Madera, Merced, and Tulare counties and encompass the most important agricultural production areas in the Central Valley and the state. All of these counties have a per capita income lower than the state average and unemployment rates approaching double the state average, based on 1997 data (Table SE-1).

**Table SE-1**
**County-Level Socioeconomic Data**

| County | 1997 Population | 1997 Civilian Labor Force | 1997 Employment | 1997 Per Capita Income | 1997 Unemployment Rate |
|---|---|---|---|---|---|
| Fresno | 786,800 | 376,200 | 322,500 | $18,329 | 14.3% |
| Kern | 639,800 | 279,300 | 245,400 | $17,848 | 12.1% |
| Tulare | 360,400 | 163,800 | 138,200 | $16,144 | 15.6% |
| Merced | 204,400 | 85,500 | 72,600 | $15,653 | 15.1% |
| Madera | 114,300 | 52,300 | 45,600 | $15,842 | 12.8% |
| **Total** | **2,105,700** | **957,100** | **824,300** | | |
| **California Average** | | **15,511,600** | **14,391,500** | **$25,368** | **6.3%** |
| **California Total** | **33,252,000** | | | | |

Source: EDD 1999, 1999a; CDF 1998

Four of these five counties are in the state's top five counties for agricultural production value, generating over 38 percent of the state's production in 1998 (Table SE-2). In addition, the Division contains 10% of the irrigated land in California.

**Table SE-2**
**Friant Division County Agricultural Production**

| County | 1998 CA Rank | 1998 Production ($1,000) | Percent of Total CA Value | Leading Crops |
|---|---|---|---|---|
| Fresno | 1 | 3,286,806 | 12.2% | Grapes, Cotton, Poultry |
| Tulare | 2 | 2,922,057 | 10.8% | Milk, Grapes, Oranges |
| Kern | 3 | 2,067,678 | 7.7% | Grapes, Citrus, Almonds |
| Merced | 5 | 1,449,754 | 5.4% | Milk, Almonds, Chickens |
| Madera | 14 | 634,307 | 2.4% | Grapes, Milk, Almonds |
| **Totals** | | **10,360,602** | **38.5%** | |
| **California Total** | | **26,941,832** | | |

Source: USDA 1999

Due to its heavy agricultural focus, 89 percent of the Division's land is irrigated. The Friant contractors receive water from the CVP, other surface water sources, and ground water pumped from both on- and off-farm sources. In 1996, total farm deliveries of water amounted to over 2.7 million af (Reclamation 2000). Ground water contributed 45% of the Division's water supply. The CVP provides water to the Division in a two-class system. Class 1 water is the set supply amounting to the first 800,000 af from the San Joaquin River and Millerton Reservoir. Class 2 water is granted only if surplus water is available. The CVP has contracts with the Friant Division for 800,000 af of Class 1 water and 1,401,475 af of Class 2 water. In 1996 almost 1.5 million af were delivered from the CVP, accounting for almost 60% of Friant's total water supply (Table SE-3).

**Table SE-3**
**Irrigated Acreage and CVP Deliveries**

| County | District | 1996 Irrigated Acres | 1996 CVP Water Deliveries (ac-ft) |
|---|---|---|---|
| **Friant-Kern Canal Service Area** | | 711,329 | 928,741 |
| Kern | Arvin-Edison Water District | 129,340 | 163,078 |
| Tulare | Delano-Earlimart Irrigation District | 50,322 | 140,294 |
| Tulare | Exeter Irrigation District | 11,514 | 18,547 |
| Fresno | Fresno Irrigation District | 158,048 | 15,107 |
| Tulare | Ivanhoe Irrigation District | 10,532 | 12,598 |
| Tulare | Lindmore Irrigation District | 24,170 | 46,383 |
| Tulare | Lindsay-Strathmore Irrigation District | 12,974 | 24,541 |
| Tulare | Lower Tule River Irrigation District | 87,890 | 195,219 |
| Tulare/Kern | Orange Cove Irrigation District | 28,000 | 34,822 |
| Tulare | Porterville Irrigation District | 13,324 | 13,786 |
| Tulare | Saucelito Irrigation District | 18,773 | 49,369 |
| Kern | Shafter-Wasco Irrigation District | 31,778 | 67,283 |
| Kern | Southern San Joaquin Municipal Utility District | 49,035 | 0 |
| Tulare | Stone Corral Irrigation District | 5,428 | 8,394 |
| Tulare | Tea Pot Dome Water District | 2,738 | 6,701 |
| Tulare | Terra Bella Irrigation District | 10,838 | 19,866 |
| Tulare | Tulare Irrigation District | 66,615 | 112,753 |
| | | | |
| **Madera Canal Service Area** | | 160,952 | 385,378 |
| Madera/Merced | Chowchilla Water District | 64,285 | 138,738 |
| Madera | Madera Irrigation District | 96,667 | 246,640 |
| | | | |
| **Downstream San Joaquin River Service Area** | | 8,468 | 8,402 |
| Madera | Gravelly Ford Water District | 880,749 | 1,322,521 |
| | | | |
| **Total** | | 880,749 | 1,322,521 |

Source: Reclamation 2000

The Friant Division produces a diverse range of crops on 896,112 acres of agricultural land: cotton, fruits, vegetables, nuts, grains, and field crops (Table SE-4). Several of the districts were not required to report crop water use information in 1996 due to limited irrigation acreage. From the reported information, grapes were the most plentiful crop in the Division with over 25% of the crop land devoted to wine, table, and raisin varieties. The Fresno Irrigation District led the Division in grape acreage with over 77,000 acres, almost half its total acres. Cotton and citrus fruits were each planted on over 10% of Friant's land. The largest producer of cotton was Lower Tule River Irrigation District (19,024 acres), and Orange Cove Irrigation District had the largest citrus acreage with 20,690 acres devoted to the crop. Thirty-one other crops each contributed less than five percent of the crop land in the Division (Reclamation 1999c).

## Table SE-4
## 1996 District Crop Acreage

| Crop | Arvin-Edison Water District | Chowchilla Water District (1989) | Delano-Earlimart Irrigation District | Exeter Irrigation District | Fresno Irrigation District (1989) | Gravelly Ford Water District (1989) | Ivanhoe Irrigation District | Lindmore Irrigation District | Lindsay-Strathmore Irrigation District | Lower Tule River Irrigation District | Madera Irrigation District | Orange Cove Irrigation District | Porterville Irrigation District | Saucelito Irrigation District | Shafter-Wasco Irrigation District | Southern San Joaquin Municipal Utility District | Stone Corral Irrigation District | Tea Pot Dome Water District (19??) | Terra Bella Irrigation District | Tulare Irrigation District | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alfalfa | 2,143 | 9,438 | 2,717 | 0 | 10,207 | 540 | 41 | 1,130 | 0 | 20,635 | 2,376 | 0 | 686 | 765 | 4,141 | 4,281 | 0 | 0 | 0 | 9,245 | 68,34 |
| Almonds | 3,958 | 11,177 | 0 | 0 | 0 | 1,337 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10,081 | 0 | 0 | 0 | 0 | 0 | 26,55 |
| Apples | 1,570 | 1,751 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,32 |
| Apricots | 341 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 34 |
| Beans | 0 | 121 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 921 | 0 | 0 | 0 | 0 | 0 | 1,04 |
| Carrots | 15,843 | 46 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15,88 |
| Citrus | 12,504 | 0 | 1,175 | 9,377 | 7,484 | 0 | 9,421 | 10,562 | 0 | 88 | 2,817 | 20,690 | 546 | 205 | 0 | 4,041 | 3,086 | 2,672 | 7,903 | 0 | 92,57 |
| Corn | 464 | 8,173 | 672 | 0 | 4,820 | 0 | 0 | 569 | 0 | 22,629 | 1,966 | 0 | 1,838 | 0 | 90 | 1,094 | 10 | 0 | 0 | 7,312 | 49,63 |
| Cotton | 15,535 | 16,687 | 2,193 | 0 | 11,901 | 762 | 0 | 2,791 | 0 | 19,024 | 3,122 | 0 | 1,438 | 2,841 | 8,200 | 7,469 | 540 | 0 | 0 | 15,953 | 108,45 |
| Deciduous Orchard | 687 | 0 | 1,592 | 0 | 10,776 | 0 | 270 | 1,424 | 0 | 3,772 | 6,442 | 4,095 | 2,196 | 1,925 | 422 | 1,368 | 1,157 | 0 | 533 | 0 | 36,65 |
| Figs | 0 | 1,147 | 0 | 0 | 4,746 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,89 |
| Grains | 6,046 | 165 | 261 | 0 | 1,165 | 0 | 0 | 625 | 0 | 11,118 | 3,399 | 0 | 1,190 | 0 | 302 | 1,297 | 90 | 0 | 0 | 0 | 25,65 |
| Grapes | 26,913 | 5,271 | 31,757 | 0 | 77,194 | 3,396 | 10 | 968 | 0 | 2,810 | 57,401 | 2,193 | 932 | 4,579 | 1,466 | 12,925 | 200 | 0 | 0 | 0 | 228,01 |
| Grass | 0 | 320 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 32 |
| Kiwifruit | 0 | 0 | 0 | 0 | 0 | 0 | 103 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Melons | 3,250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 144 | 0 | 0 | 0 | 0 | 0 | 3,39 |
| Miscellaneous | 0 | 151 | 0 | 1,034 | 0 | 240 | 0 | 2,361 | 1,330 | 890 | 1,123 | 1,022 | 808 | 464 | 0 | 0 | 0 | 164 | 473 | 11,561 | 21,62 |
| Misc. Truck | 230 | 0 | 1,087 | 0 | 7,913 | 0 | 0 | 0 | 0 | 1,077 | 930 | 0 | 183 | 0 | 1,224 | 545 | 0 | 0 | 0 | 0 | 13,18 |
| Nursery | 218 | 49 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,885 | 438 | 0 | 0 | 0 | 0 | 2,59 |
| Nuts | 0 | 0 | 9,404 | 0 | 12,561 | 0 | 0 | 218 | 0 | 3,359 | 24,023 | 0 | 2,769 | 2,796 | 0 | 15,304 | 0 | 0 | 597 | 0 | 71,03 |
| Oats | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Olives | 0 | 0 | 0 | 912 | 0 | 0 | 669 | 4,861 | 1,620 | 0 | 0 | 0 | 206 | 0 | 0 | 57 | 0 | 245 | 562 | 0 | 9,13 |
| Onions | 6,775 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,77 |
| Oranges | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9,750 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9,75 |
| Pasture | 420 | 3,235 | 114 | 0 | 14,353 | 0 | 0 | 0 | 0 | 551 | 4,059 | 0 | 458 | 0 | 168 | 10 | 80 | 0 | 0 | 0 | 23,44 |
| Peas | 0 | 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| Peaches/Nect. | 3,766 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,76 |
| Peppers | 754 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 75 |
| Pistachios | 168 | 1,126 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,29 |
| Plums | 521 | 0 | 0 | 889 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,41 |
| Pomegranates | 0 | 37 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Potatoes | 23,976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,255 | 0 | 0 | 0 | 0 | 0 | 25,23 |
| Subtropical Orchard | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 431 | 0 | 0 | 0 | 0 | 0 | 43 |
| Sugar Beets | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 72 | 0 | 418 | 0 | 0 | 0 | 0 | 191 | 216 | 0 | 0 | 0 | 0 | 89 |

## Table SE-4
## 1996 District Crop Acreage

| Crop | Arvin-Edison Water District | Chowchilla Water District (1989) | Delano-Earlimart Irrigation District | Exeter Irrigation District | Fresno Irrigation District (1989) | Gravelly Ford Water District (1989) | Ivanhoe Irrigation District | Lindmore Irrigation District | Lindsay-Strathmore Irrigation District | Lower Tule River Irrigation District | Madera Irrigation District | Orange Cove Irrigation District | Porterville Irrigation District | Saucelito Irrigation District | Shafter-Wasco Irrigation District | Southern San Joaquin Municipal Utility District | Stone Corral Irrigation District | Tea Pot Dome Water District (19??) | Terra Bella Irrigation District | Tulare Irrigation District | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tomatoes | 2,651 | 93 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,74 |
| Walnuts | 607 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 62 |
| Wheat | 0 | 7,551 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,127 | 1,583 | 0 | 0 | 200 | 0 | 21,646 | 35,10 |
| **Total** | **129,340** | **66,638** | **50,972** | **12,212** | **163,120** | **6,275** | **10,514** | **25,581** | **12,700** | **86,371** | **107,658** | **28,000** | **13,250** | **17,702** | **32,504** | **49,045** | **5,163** | **3,281** | **10,068** | **65,717** | **896,11** |

Note:
Fresno County Waterworks #18, Garfield Water District, International Water District, Lewis Creek Water District, County of Madera, and City of Orange Cove are exempt from reporting crop water needs information. No information was available for the City of Fresno and the City of Lindsay.

Source: Reclamation 1999c

Within the Kern County portion of the Friant Division, the most abundant of the 29 crops were grapes with approximately 41,000 acres. Grapes were also the primary crop in the Division areas of Madera and Fresno counties, comprising approximately 66,000 and 77,000 acres, respectively. Of the 17 crops grown in the Tulare county portion of the Division, citrus trees were predominant, occupying over 65,000 of the 341,000 acres (Reclamation 1999c).

The Friant Division is a major contributor to the production of several crops in California (Figure SE-1). Of the 706,731 acres of the grapes grown in California, 64% are produced by the five counties which encompass the Division. Friant is also a substantial supplier of cotton (CASS 1995).

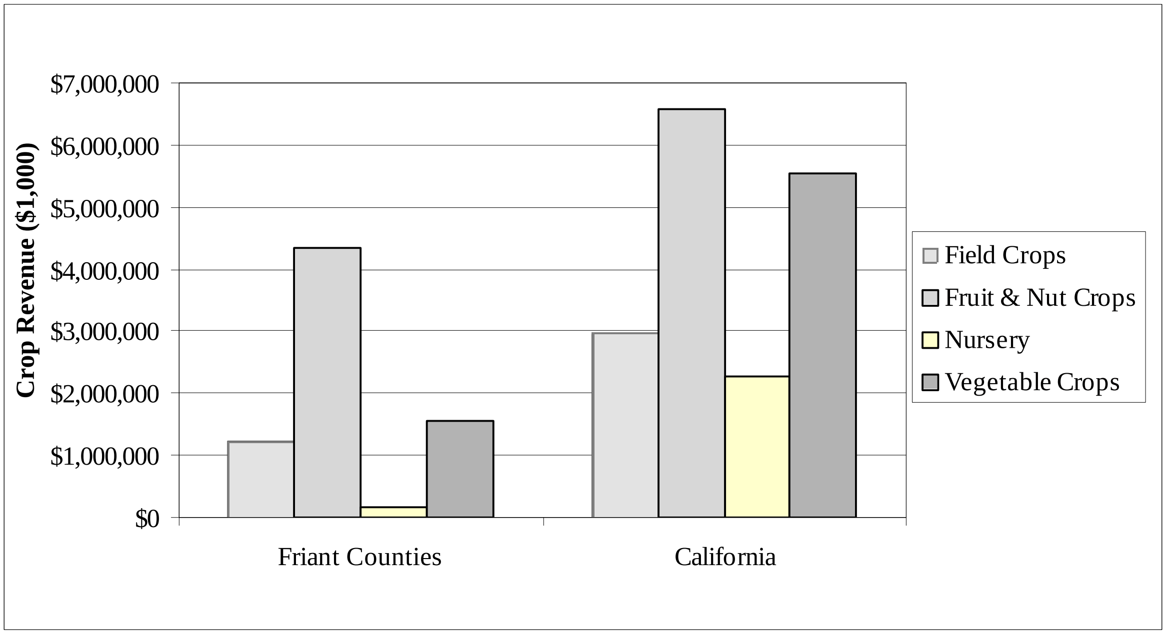



**Figure SE-1**
**Crop Revenue Distribution for Friant Counties and California**
Source: Cass 1995

CVP contract rates for Class 1 water in the Division average $18.22 per ac-ft. Tulare Irrigation District has the least expensive rate of $17.08/ac-ft and Garfield Water District is the most expensive at $24.50/ac-ft. The rate of Class 2 water varies much more widely than Class 1 water. The range for Class 2 rates is $4.34/ac-ft for Gravelly Ford Water District to $17.90/ac-ft for Chowchilla Water District, with an average of $8.91/ac-ft (Reclamation 1999c).

On-farm water application efficiency is a function of evapotranspiration and the amount of water delivered to the farm. Application efficiencies in the Central Valley range from around 50% to 80% (Reclamation 1999c). The Friant Division lies in the high part of that range. The Division's service areas have efficiencies ranging from 72.4% to 78.5%, with an average of 77.4%. Ground water replenishment is highest in the Friant-Kern Canal service area with almost 650,000 ac-ft, and lowest in the downstream San Joaquin River service area with only 7,200 ac-ft (FWUA 1998).

In 1995, the Friant Division generated over $1.3 billion in crop revenue (Table SE-5), which is 17% of the revenue for its five counties. Friant's agricultural revenue was 9% of the Central Valley's and 5% of California's for 1996. The top two districts, Arvin-Edison Water District and Fresno Irrigation District, each contributed approximately 20% of the Division's production (Reclamation 1999c, 1999a). The greatest revenues came from the Division's crops with the highest irrigated acreage. Grapes were the largest revenue producers contributing over a half a billion dollars. Citrus and cotton crops followed with approximately $345 million and $110 million, respectively. The top three districts made up 73% of the Division's revenue but had contracts for only 17% of the Division's Class 1 water (Table SE-6).

**Table SE-5**
**1996 Crop Revenue ($1,000)**

| Crop | Arvin-Edison Water District | Chowchilla Water District | Delano-Earlimart Irrigation District | Exeter Irrigation District | Fresno Irrigation District | Gravelly Ford Water District | Ivanhoe Irrigation District | Lindmore Irrigation District | Lindsay-Strathmore Irrigation District | Lower Tule River Irrigation District | Madera Irrigation District | Orange Cove Irrigation District | Porterville Irrigation District | Saucelito Irrigation District | Shafter-Wasco Irrigation District | Southern San Joaquin Municipal | Stone Corral Irrigation District | Tea Pot Dome Water District | Terra Bella Irrigation District | Tulare Irrigation District | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alfalfa | $1,438 | $6,333 | $1,823 | $0 | $6,849 | $362 | $27 | $758 | $0 | $13,846 | $1,594 | $0 | $460 | $513 | $2,779 | $2,873 | $0 | $0 | $0 | $6,203 | $45,859 |
| Almonds | $6,301 | $17,793 | $0 | $0 | $0 | $2,129 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $16,049 | $0 | $0 | $0 | $0 | $0 | $42,272 |
| Apples | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | $0 |
| Apricots | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | $0 |
| Beans | $0 | $74 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $567 | $0 | $0 | $0 | $0 | $0 | $642 |
| Carrots | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | $0 |
| Citrus | $46,565 | $0 | $4,376 | $34,920 | $27,870 | $0 | $35,085 | $39,333 | $0 | $328 | $10,491 | $77,050 | $2,033 | $763 | $0 | $15,049 | $11,492 | $9,951 | $29,431 | $0 | $344,73 |
| Corn | $217 | $3,825 | $314 | $0 | $2,256 | $0 | $0 | $266 | $0 | $10,590 | $920 | $0 | $860 | $0 | $42 | $512 | $5 | $0 | $0 | $3,422 | $23,230 |
| Cotton | $15,690 | $16,854 | $2,215 | $0 | $12,020 | $770 | $0 | $2,819 | $0 | $19,214 | $3,153 | $0 | $1,452 | $2,869 | $8,282 | $7,544 | $545 | $0 | $0 | $16,113 | $109,54 |
| Deciduous | -- | – | -- | -- | – | -- | -- | – | -- | -- | -- | -- | – | -- | -- | -- | -- | -- | -- | -- | $0 |
| Figs | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | $0 |
| Grains | $1,475 | $40 | $64 | $0 | $284 | $0 | $0 | $153 | $0 | $2,713 | $829 | $0 | $290 | $0 | $74 | $316 | $22 | $0 | $0 | $0 | $6,260 |
| Grapes | $59,168 | $11,588 | $69,818 | $0 | $169,711 | $7,466 | $22 | $2,128 | $0 | $6,178 | $126,196 | $4,821 | $2,049 | $10,067 | $3,223 | $28,416 | $440 | $0 | $0 | $0 | $501,29 |
| Grass | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | $0 |
| Kiwifruit | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | $0 |
| Melons | $61,230 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $2,713 | $0 | $0 | $0 | $0 | $0 | $63,943 |
| Misc. Truck | $1,039 | $0 | $4,912 | $0 | $35,759 | $0 | $0 | $0 | $0 | $4,867 | $4,203 | $0 | $827 | $0 | $5,531 | $2,463 | $0 | $0 | $0 | $0 | $59,601 |
| Miscellaneo | -- | -- | -- | – | -- | -- | -- | – | -- | -- | -- | -- | -- | -- | – | -- | -- | – | -- | -- | $0 |
| Nursery | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | $0 |
| Nuts | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | $0 |
| Oats | $0 | $5 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $5 |
| Olives | $0 | $0 | $0 | $1,726 | $0 | $0 | $1,267 | $9,202 | $3,067 | $0 | $0 | $0 | $390 | $0 | $0 | $108 | $0 | $464 | $1,064 | $0 | $17,288 |
| Onions | $15,088 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $15,088 |
| Oranges | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | $0 |
| Pasture | $68 | $527 | $19 | $0 | $2,340 | $0 | $0 | $0 | $0 | $90 | $662 | $0 | $75 | $0 | $27 | $2 | $13 | $0 | $0 | $0 | $3,822 |

## Table SE-5
## 1996 Crop Revenue ($1,000)

| Crop | Arvin-Edison Water District | Chowchilla Water District | Delano-Earlimart Irrigation District | Exeter Irrigation District | Fresno Irrigation District | Gravelly Ford Water District | Ivanhoe Irrigation District | Lindmore Irrigation District | Lindsay-Strathmore Irrigation District | Lower Tule River Irrigation District | Madera Irrigation District | Orange Cove Irrigation District | Porterville Irrigation District | Saucelito Irrigation District | Shafter-Wasco Irrigation District | Southern San Joaquin Municipal | Stone Corral Irrigation District | Tea Pot Dome Water District | Terra Bella Irrigation District | Tulare Irrigation District | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Peaches/Nec | $17,610 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $17,610 |
| Peas | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | $0 |
| Peppers | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | $0 |
| Pistachios | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | $0 |
| Plums | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | $0 |
| Pomegranat | -- | – | -- | -- | -- | -- | – | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | $0 |
| Potatoes | $79,576 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $4,165 | $0 | $0 | $0 | $0 | $0 | $83,742 |
| Subtropical | -- | – | -- | -- | -- | -- | – | -- | -- | -- | -- | -- | -- | -- | -- | – | -- | -- | – | -- | $0 |
| Sugar Beets | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $65 | $0 | $380 | $0 | $0 | $0 | $0 | $174 | $196 | $0 | $0 | $0 | $0 | $815 |
| Tomatoes | $15,161 | $532 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $15,693 |
| Walnuts | $850 | $20 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $871 |
| Wheat | $0 | $2,454 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $1,341 | $514 | $0 | $0 | $65 | $0 | $7,035 | $11,410 |
| Total | $321,478 | $60,045 | $83,540 | $36,646 | $257,089 | $10,727 | $36,402 | $54,724 | $3,067 | $58,206 | $148,048 | $81,871 | $8,437 | $15,554 | $44,141 | $57,478 | $12,517 | $10,479 | $30,495 | $32,773 | $1,363,[illegible] |

– Not Available

Note: Fresno County Waterworks #18, Garfield Water District, International Water District, Lewis Creek Water District, County of Madera, and City of Orange Cove are exempt from reporting crop water needs information. No information was available for the City of Fresno and the City of Lindsay.

Source: Reclamation 1999b; Reclamation 1999c

**Table SE-6**
**District Agricultural Revenue and Contract Water**

| Reporting Districts | Class 1 Contract Water Amount (ac-ft/yr) | Class 2* Contract Water Amount (ac-ft/yr) | 1996 Crop Revenue | Cumulative Revenue |
|---|---|---|---|---|
| Arvin-Edison Water District | 40,000 | 311,675 | $266,371,333 | $266,371,333 |
| Fresno Irrigation District | 0 | 75,000 | $257,088,738 | $523,460,071 |
| Madera Irrigation District | 85,000 | 186,000 | $148,047,854 | $671,507,924 |
| Delano-Earlimart Irrigation District | 108,800 | 74,500 | $83,540,417 | $755,048,341 |
| Orange Cove Irrigation District | 39,200 | 0 | $81,870,871 | $836,919,211 |
| Chowchilla Water District | 55,000 | 160,000 | $60,045,063 | $896,964,274 |
| Lower Tule River Irrigation District | 61,200 | 238,000 | $58,205,724 | $955,169,998 |
| Southern San Joaquin M.U.D. | 97,000 | 50,000 | $57,477,728 | $1,012,647,726 |
| Lindmore Irrigation District | 33,000 | 22,000 | $54,724,289 | $1,067,372,015 |
| Shafter-Wasco Irrigation District | 50,000 | 39,600 | $41,699,083 | $1,109,071,098 |
| Exeter Irrigation District | 11,500 | 19,000 | $36,646,364 | $1,145,717,462 |
| Ivanhoe Irrigation District | 7,700 | 7,900 | $36,401,831 | $1,182,119,293 |
| Tulare Irrigation District | 30,000 | 141,000 | $32,772,891 | $1,214,892,184 |
| Terra Bella Irrigation District | 29,000 | 0 | $30,494,638 | $1,245,386,822 |
| Saucelito Irrigation District | 21,200 | 32,800 | $15,554,352 | $1,260,941,174 |
| Stone Corral Irrigation District | 10,000 | 0 | $12,517,044 | $1,273,458,218 |
| Gravelly Ford Water District | 0 | 14,000 | $10,726,570 | $1,284,184,788 |
| Tea Pot Dome Water District | 7,500 | 0 | $10,479,313 | $1,294,664,101 |
| Porterville Irrigation District | 16,000 | 30,000 | $8,437,125 | $1,303,101,226 |
| Lindsay-Strathmore Irrigation District | 27,500 | 0 | $3,066,660 | $1,306,167,886 |

Source: FWUA 1998; Reclamation 1999a; 1999c

*Class 2 water available only after all of Class 1 entitlements have been met.

## Environmental Consequences

The majority of the data presented in this assessment is derived from the Central Valley Production Model (CVPM). The CVPM, as defined in the Draft PEIS, is "...a regional model of irrigated agricultural production and economics that simulates the decisions of agricultural producers (farmers) in the Central Valley of California." The model contains 22 crop production regions. The Friant Division falls within six of the CVPM 22 subregions that include subregions 13, 16, 17, 18, 20, and 21. While the Friant Division is contained within these six subregions, it should be noted that the existing conditions for the Division are less than 100 percent of the production units used in the CVPM. This is because the CVPM subregions include both CVP and non-CVP users. For example, the total irrigated acreage from the affected environment section of this EA will be different (lower) than the irrigated acreage used in this analysis. For the purposes of these analyses, however, the impacts generated by the CVPM for subregions 13, 16, 17, 18, 20, and 21 will be considered the same as the impacts to the Friant Division.

***No Action Alternative***

The impacts to acreage, agricultural output, and employment are derived from the Final PEIS Alternative 1 (Reclamation 1999a). The assumptions used in the analysis and the results are detailed in that report. The PEIS Alternative 1 output was considered equivalent to the output for the PEIS Preferred Alternative, and was applied to the NAA for this EA. The NAA for this EA includes dedication of water for alternative uses, restoration payments, tiered water prices, and land retirement.

The distribution of the crop acreages among the Division's CVPM subregions estimated for the NAA in the average year water condition equal 2,058,000 acres. In a wet year the total acreage is raised by less than 1%. In a dry year this total drops by less than 2%, which is a change of less than 0.5% of the Central Valley total irrigated acreage for an average year. CVPM subregion 18 contributed to half of this drop in acreage, losing 15,000 acres in a dry year (Table SE-7). These changes are relatively small and are consistent with changes due to weather and commodity demand.

**Table SE-7**
**Irrigated Acreage: No Action Alternative**

| CVPM Subregion | Average Year (1922-1990) | Wet Year (1967-1971) | Dry Year (1928-1934) |
|---|---|---|---|
| 13 | 533 | 534 | 532 |
| 16 | 111 | 112 | 110 |
| 17 | 260 | 260 | 256 |
| 18 | 592 | 595 | 577 |
| 20 | 203 | 204 | 199 |
| 21 | 359 | 359 | 354 |
| **Total** | 2,058 | 2,064 | 2,028 |

Source: USBR 1999a
Note:
All acreage values in thousands.

Gross revenues among the Division's CVPM subregions for the PEIS NAA Average amount to $4.128 million, which is 41% of total Central Valley gross revenue. In a dry year gross revenue falls by less than 1% of this total, with subregion 18 once again contributing half of the lost revenue. In a wet year gross revenue is increased by less than 1% of the average year total (Table SE-8).

**Table SE-8**
**Friant Division Gross Revenue (Value of Production) in the No Action Alternative**

| CVPM Subregion | Average Year (1922-90) | Wet Year (1967-71) | Dry Year (1928-34) |
|---|---|---|---|
| 13 | 710.6 | 711.5 | 709.9 |
| 16 | 224.3 | 224.5 | 224.2 |
| 17 | 565.7 | 565.7 | 562.0 |
| 18 | 974.2 | 976.1 | 961.5 |
| 20 | 603.9 | 604.1 | 600.4 |
| 21 | 1047.6 | 1047.6 | 1045.7 |
| **Total** | 4126.3 | 4129.5 | 4103.7 |

Source: CH2M Hill 2000
Note:
All values in millions of 1992 dollars.

Friant Division's CVPM subregions produce about 40% of Central valley net income total. In a wet year, net income decreases to about 72% of the Central Valley net total with the majority of the decrease resulting from irrigation cost. In a dry year, net income decreases even more to about 31% of the Central Valley total, with the majority of the decrease resulting from ground water pumping (Table SE-9).

**Table SE-9**
**Friant Division Net Revenue in the No Action Alternative**

| CVPM Subregion | Average Year (1922-90) | Wet Year (1967-71) | Dry Year (1928-34) |
|---|---|---|---|
| 13 | 211.4 | 18.7 | 3.3 |
| 16 | 51.0 | 25.7 | 21.6 |
| 17 | 142.9 | 54.2 | 41.5 |
| 18 | 294.7 | 25.3 | 3.4 |
| 20 | 136.5 | 31.5 | 17.2 |
| 21 | 207.6 | 28.5 | 2.1 |
| **Total** | 1,044.1 | 183.9 | 82.3 |

Source: CH2M Hill 2000
Note:
All values in millions of 1992 dollars

Compared to the NAA average scenarios, ground water usage increases about 1,140 af and CVP water usage decreases about 270 af under the NAA dry scenario of the PEIS. The NAA wet scenario shows a decrease in ground water use of about 650 af and a slight increase in total CVP water use of about 40 af compared to the NAA average scenario (Table SE-10). These water source estimates give insight into the insignificant changes in agricultural output and revenue summarized in the previous sections. While changes in output and revenue under the NAA are insignificant, tradeoff between CVP water and ground water is substantial, with total ground water use in a dry year increasing by 35%, and in a wet year decreasing by 20%. The evidence shows that when surface water supplies are restricted, farmers will switch to ground water, greatly softening the economic impacts of changes in CVP supplies. Therefore, impacts on agricultural output and revenue are minimal within the Friant Division. It should be noted, however, that in production areas where ground water resources are not readily available or are of poor quality, localized impacts could result.

**Table SE-10**
**Friant Division Irrigation Water Applied**

| CVPM Subregion | Water Source | Average Year (1922-90) | Wet Year (1967-71) | Dry Year (1928-34) |
|---|---|---|---|---|
| 13 | CVP Water | 163.6 | 159.0 | 128.2 |
| | Ground water | 912.5 | 812.0 | 1181.4 |
| 16 | CVP Water | 16.2 | 15.7 | 12.9 |
| | Ground water | 49.6 | 0.0 | 107.3 |
| 17 | CVP Water | 34.6 | 32.5 | 27.1 |
| | Ground water | 415.1 | 303.2 | 577.4 |
| 18 | CVP Water | 517.3 | 526.3 | 399.0 |
| | Ground water | 1018.0 | 821.8 | 1334.9 |
| 20 | CVP Water | 208.7 | 219.8 | 154.1 |
| | Ground water | 303.6 | 244.8 | 437.3 |
| 21 | CVP Water | 138.3 | 163.0 | 89.3 |
| | Ground water | 579.4 | 445.2 | 783.1 |
| **Total** | CVP Water | 1078.7 | 1116.3 | 810.6 |
| | Ground water | 3278.2 | 2627.0 | 4421.4 |

Source: CH2M Hill 2000
Notes:
All values in af.

The PEIS estimated the total employment impacts for California to be about 2,790 jobs, $183 million in output, and $79.6 million in place-of-work (PoW) income. Most of these impacts occur in agricultural regions where CVP water prices cause substantial decreases in agricultural output. The estimates from the PEIS IMPLAN employment multipliers indicate about 20 jobs per million dollars of output (See Draft PEIS Technical Appendix, Regional Economics, Table II-2, Page II-5). Therefore, the less than one percent increase in wet year Central Valley output will increase total employment in the Central Valley by about 130 jobs. The dry year analysis shows that a less than one percent decrease in output for the Central Valley will result in a decrease of about 935 jobs for the region, a very small percentage of the total regional employment impact of the implementation of PEIS. Therefore, it is concluded that no employment impacts are likely to occur.

***Alternative 1***

The impacts are similar to the NAA. Therefore, no impacts on agricultural output and revenue and employment impacts are anticipated within the Friant Division.

***Alternative 2***

The impacts to acreage, agricultural output, and employment are derived from the *Economic Analysis of November 1999 Tiered Pricing Proposal for PEIS Preferred Alternative* (CH2M Hill 2000). The assumptions used in the analysis and the results are detailed in that report. This alternative includes tiered water prices based on the November 1999 proposal to the PEIS Preferred Alternative and 1999 water rates.

Changes in irrigated acreage within the Friant Division from the NAA are summarized in Table SE-11. Less than one percent of the Friant Division's irrigated acres are lost compared with the NAA, when a wet year follows a series of dry years. This reduction is the largest in irrigated acreage due to the implementation of the tiered pricing procedure described in Alternative 2. According to this tiered pricing procedure, the amount of water that is eligible for Category 1 classification shrinks when a series of dry years is experienced because of the fact that the quantity of Category 1 water is based on the average deliveries of the previous five years. This being the case, when a series of average or dry years is followed by a wet year, a large portion of the water that is available is classified as Category 2 and is priced at the Full Cost Rate. When this full cost water is integrated into the blended water price, all CVP water supplies become more expensive. The less than one percent change in irrigated acreage in the dry-wet scenario, like those under the NAA, is relatively small and is consistent with changes due to weather and commodity demand.

**Table SE-11**
**Irrigated Acreage Alternative 2**

| CVPM Subregion | Changes Compared to Average NAA | | | Changes Compared to Wet NAA | | | Changes Compared to Dry NAA | | |
|---|---|---|---|---|---|---|---|---|---|
| | Avg. | Wet | Dry | Avg. | Wet | Dry | Avg. | Wet | Dry |
| | Followed by Average | | | Followed by Wet | | | Followed by Dry | | |
| 13 | 0.0 | 0.0 | 0.0 | -0.8 | -0.8 | -1.1 | -0.9 | -0.9 | -0.9 |
| 16 | -0.1 | -0.1 | 0.0 | -0.4 | -0.4 | -0.4 | -0.1 | -0.1 | -0.1 |
| 17 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 18 | 0.0 | 0.0 | -0.1 | -1.2 | -1.2 | -1.2 | 0.1 | 0.1 | 0.1 |
| 20 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 21 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Total** | -0.1 | -0.1 | -0.1 | -2.4 | -2.4 | -2.7 | -0.9 | -0.9 | -0.9 |

Source: CH2M Hill 2000
Note:
All values in thousands acres.

Gross revenue impacts are very similar to the acreage impacts, and are shown in Table SE-12. Compared to the NAA wet, a reduction of $1.7 million is estimated for the average-wet and wet-wet scenarios, and a $1.9 million reduction is estimated in the dry-wet scenario. Each of these three scenarios decrease reduce gross revenue in the Friant Division by less than one percent.

**Table SE-12**
**Friant Division Gross Revenue (Value of Production) in Alternative 2**

| CVPM Subregion | Changes Compared to Average NAA | | | Changes Compared to Wet NAA | | | Changes Compared to Dry NAA | | |
|---|---|---|---|---|---|---|---|---|---|
| | Avg. | Wet | Dry | Avg. | Wet | Dry | Avg. | Wet | Dry |
| | Followed by Average | | | Followed by Wet | | | Followed by Dry | | |
| 13 | 0.0 | 0.0 | 0.0 | -0.5 | -0.5 | -0.7 | -0.6 | -0.6 | -0.6 |
| 16 | 0.0 | 0.0 | 0.0 | -0.2 | -0.2 | -0.2 | 0.0 | 0.0 | 0.0 |
| 17 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 18 | 0.0 | 0.0 | -0.1 | -1.0 | -1.0 | -1.0 | 0.1 | 0.1 | 0.1 |
| 20 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 21 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | 0.0 | 0.0 | -0.1 | -1.7 | -1.7 | -1.9 | -0.5 | -0.5 | -0.5 |

Source: CH2M Hill 2000
Note:
All values in millions of dollars.

Estimated changes in net revenue within the Friant Division are the largest for the dry-wet and dry-average scenarios. For the series of dry years followed by a wet year, net revenue is decreased by less than 1% of the Division's total net revenue compared to the NAA average year results. When dry years were followed by an average year, the net revenue decreased by an even smaller percentage (Table SE-13).

**Table SE-13**
**Friant Division Net Revenue in Alternative 2**

| CVPM Subregion | Changes Compared to Average NAA | | | Changes Compared to Wet NAA | | | Changes Compared to Dry NAA | | |
|---|---|---|---|---|---|---|---|---|---|
| | Avg. | Wet | Dry | Avg. | Wet | Dry | Avg. | Wet | Dry |
| | Followed by Average | | | Followed by Wet | | | Followed by Dry | | |
| 13 | 0.0 | 0.1 | -0.1 | -0.1 | 0.0 | -0.5 | -0.1 | -0.1 | -0.3 |
| 16 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 |
| 17 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | -0.1 | 0.0 | 0.0 | -0.1 |
| 18 | -1.5 | -1.0 | -2.9 | -2.1 | -1.6 | -3.7 | 0.8 | 0.8 | 0.0 |
| 20 | -0.1 | 0.2 | -0.8 | -0.3 | 0.0 | -1.1 | -0.3 | -0.3 | -0.7 |
| 21 | 0.1 | 0.3 | -0.3 | 0.4 | 0.7 | -0.1 | -1.5 | -1.5 | -1.7 |
| **Total** | -1.5 | -0.3 | -3.9 | -2.0 | -0.8 | -5.4 | -1.1 | -1.1 | -2.8 |

Source: CH2M Hill 2000
Note: All values in millions of dollars.

Compared to the NAA average year within the Friant Division, CVP water usage decreases 1% and ground water usage increases less than 1% when an average year follows a series of dry years (Table SE-14). These data follow closely with the evidence provided under the NAA analysis and, in fact, show an almost negligible difference in comparison with that analysis. In the Alternative 2 analysis, water supplies other than CVP project water and ground water are unaffected and not shown.

**Table SE-14**
**Friant Division Irrigation Water Applied in Alternative 2**

| CVPM Subregion | Water Source | Changes Compared to Average NAA | | | Changes Compared to Wet NAA | | | Changes Compared to Dry NAA | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Avg. | Wet | Dry | Avg. | Wet | Dry | Avg. | Wet | Dry |
| | | Followed by Average | | | Followed by Average | | | Followed by Average | | |
| 13 | CVP Water | 16.7 | 16.6 | -60.2 | 33.2 | 33.1 | -113.1 | 0.0 | 0.0 | 0.0 |
| | Ground Water | -16.7 | -16.6 | 60.2 | -36.2 | -36.1 | -109.1 | -3.8 | -3.8 | -3.8 |
| 16 | CVP Water | -16.2 | -16.2 | -16.2 | -15.7 | -15.7 | -15.7 | -12.9 | -12.9 | -12.9 |
| | Ground Water | 14.9 | 14.8 | 15.0 | 13.2 | 13.2 | 13.2 | 11.5 | 11.5 | 11.5 |
| 17 | CVP Water | 3.9 | 3.8 | 4.0 | 7.4 | 7.3 | 7.4 | 0.0 | 0.0 | 0.1 |
| | Ground Water | -3.8 | -3.8 | -3.9 | -7.4 | -7.2 | -7.4 | 0.0 | 0.0 | 0.0 |
| 18 | CVP Water | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 |
| | Ground Water | 0.0 | 0.0 | -0.1 | -4.0 | -4.0 | -3.8 | 0.0 | 0.0 | 0.0 |
| 20 | CVP Water | 0.1 | 0.1 | -0.2 | 0.1 | 0.1 | -0.1 | 0.0 | 0.0 | -0.1 |
| | Ground Water | -0.1 | -0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 21 | CVP Water | 0.0 | 0.0 | -0.1 | 0.0 | 0.1 | -0.1 | 0.0 | 0.0 | -0.1 |
| | Ground Water | 0.0 | 0.0 | 0.1 | 0.0 | -0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Total** | CVP Water | -12.2 | -12.2 | -12.3 | -8.2 | -8.1 | -8.4 | -12.9 | -12.9 | -12.9 |
| | Ground Water | 11.0 | 10.8 | 10.9 | 1.8 | 1.9 | 2.0 | 11.5 | 11.5 | 11.5 |

Source: CH2M Hill 2000
Note: All values in thousands af.

The Alternative 2 analysis estimated the total California impacts for the average-average scenario compared to the NAA to include total direct and indirect losses of about 530 jobs, $34 million in output, and $18.6 million of place-of-work income. Each of these losses amounts to less than one percent of the Central Valley total. Under the dry-average scenario, the negative total impacts to the state economy for jobs, output, and PoW income also do not exceed one percent of the Central Valley totals. The wet-average sequence produces even smaller negative impacts than the dry-average scenario. It is concluded, therefore, that there will be no impact to the total regional employment due to the implementation of Alternative 2.

## Cumulative Effects

Implementation of Alternatives 1 and 2 would continue a historic pattern of water use within the Friant Division. These actions in combination with other foreseeable actions would likely have little or no impact on agricultural water deliveries and maintain historical average water supplies. Therefore, the implementation of either of the alternatives would not result in any addition to cumulative impacts that would substantially affect agricultural output, revenue, or employment.

# CULTURAL RESOURCES

## Affected Environment

For cultural resources (archaeological and historical sites, and traditional cultural properties), the area of potential effect (APE) consists of the service areas of the water districts included in the Friant Division. The service area consists of 28 water districts in Fresno, Kern, Madera, Merced, and Tulare counties and includes mostly agricultural users but also some municipal and industrial users.

This discussion was developed from published sources including *California Archaeology* by Michael Moratto (1984) and the *Handbook of North American Indians*, Volume 8, California (Wallace 1978) and includes a presentation that establishes the environmental, prehistoric, ethnographic, and historic context for the APE. Specific cultural resource data for the project APE were obtained from the Central California Information Center at California State University Stanislaus and the Southern San Joaquin Valley Information Center at California State University Bakersfield. The Information Centers are part of the California Historical Resources Information System. All recorded archaeological and historical site records for the project area were obtained from the Information Centers.

The California Native American Heritage Commission (NAHC) was contacted to request a review of their Sacred Lands files. The NAHC also provided names of Native American groups and individuals it believes might have specific knowledge of traditional cultural properties or other cultural sites on the subject lands. These lists were forwarded to Reclamation, which is conducting government-to-government consultation with federally recognized tribes.

### *Cultural Setting*

#### ***Prehistory***

Human presence in San Joaquin Valley is demonstrated from at least 6000 BC, based on a radiocarbon date obtained from an archaeological site located on the western shore of Buena Vista Lake in the southern end of the valley. According to a scheme proposed in the 1930s, this site fits into the earliest phase of three chronological periods that have been employed to organize the prehistory of California. This first phase, known as the Early Horizon and spanning 6,000 to 500 years B.C., is associated with an early, hunting-focused culture. Its people were attracted to the vast herds of large game that frequented the waterways of the valley. This phase was followed by the emergence of a cultural pattern, known as the Middle Horizon, that was more heavily focused on the collection of seeds and other plant food. This phase occurred approximately 2500 to 1100 years ago. The third phase - the Late Horizon, 200 years ago includes the Yokuts and their immediate antecedents and saw a shift to a diversified subsistence strategy that encompassed a wide range of plant and animal foods. While this chronological scheme, known as the Central California Taxonomic System, has been revised over the years, it is still used by many archaeologists, albeit in a modified and refined fashion (Wallace 1978).

The material culture and burial practices of the aboriginal populations of the central and southern San Joaquin Valley share features with both the cultures of the Delta and with those of the Santa Barbara coast. Similarities to the Delta region can be seen in the presence of bone sweat scrapers, decorated bone spatulae, and beads of olivella and haliotis shell. However, limpet shell ornaments, a well-developed steatite industry, and the use of wooden grave markers are characteristics shared with the Santa Barbara coast (Elsasser 1978). Burials in San Joaquin Valley tend to be extended in the Early Horizon, semiflexed in the Middle Horizon, and tightly flexed in the Late Horizon and Protohistoric periods. The amount of burial goods also seems to increase over time (Moratto 1984).

Archaeological research in San Joaquin Valley, especially the southern part, has been limited. Aside from a few large sites around Buena Vista Lake, the area of the valley south of Modesto has not been intensively investigated. The far northern end of the San Joaquin Valley, around the Delta, has been more intensively investigated, but is outside the project area. It is likely that future investigations will further help to clarify the archaeological record for the area.

### *Ethnography*

Most of the territory encompassed by the Friant Division was occupied at the time of contact by the Yokuts group, the various branches of which occupied most of San Joaquin Valley, its eastern and western foothills, and the eastern part of the Delta. The Yokuts language is a member of the Penutian stock, which includes the Miwok and Costanoan (or Ohlone) groups. The Penutian peoples are thought to have entered central California from the northwestern Great Basin beginning around 1500 BC (Moratto 1984) and to have gradually displaced the previous inhabitants, speakers of Hokan and Uto-Aztecan stocks. This hypothetical population movement is associated chronologically with the development of the Windmiller pattern in Sacramento Valley, a cultural pattern characterized by diversified food-gathering strategies, including highly developed hunting and fishing technology; the pattern also features extended burials oriented towards the west. Besides the three Yokut groups, a small area in the southern part of the Friant Division were occupied by the Kitanemuk.

#### ***North Valley Yokuts***

The territory of the North Valley Yokuts extended from Fresno north to the edge of the Delta, west to the crest of the Diablo Range, and east to the lower foothills of the Sierra. The life of the North Yokuts was centered along the San Joaquin River and its many tributaries, which are flanked by dry, treeless grasslands along their lengths. The principal food sources for this group were salmon and acorns, both of which were plentiful in areas along the rivers. Procurement of avifauna, big game, and seeds also played an important role in subsistence.

Round, single-family dwellings built of reeds were the primary structure in North Yokuts villages, which were usually located on mounds to minimize flood hazards. Basketry and other fiber weaving work constituted the primary craft, accompanied by a lithics industry that manufactured tools from locally obtainable chert, jasper, and chalcedony. Footpaths connected villages, though river travel was also very important. Trade with neighboring peoples such as the Costanoans and Miwoks was common. Disruption of native lifeways began with the establishment of missions in the San Francisco Bay region and the forced conversion, often by kidnapping, of the indigenous peoples of the area. With the secularization of the missions in 1834, many former neophytes, including many North Yokuts, returned to their native regions or villages. The resumption of native lifeways, however, was interrupted by the onset of the Gold Rush. The northern San Joaquin Valley was the principal corridor for the thousands of miners who headed for the Sierra Nevada; later it was a prime choice for farmland. Most of the Native American people and villages in the way of this settlement were annihilated (Wallace 1978).

***South Valley Yokuts***

The historic homeland of the South Valley Yokuts encompassed the San Joaquin Valley south of Fresno and the surrounding foothills. The most notable aspect of this area was the presence of two large shallow lakes, Buena Vista and Tulare, and numerous rivers, channels, sloughs, and marshes. About 15 Yokuts groups inhabited this area, each with a different, yet mutually intelligible dialect. Each of these groups averaged about 350 persons. They occupied permanent dwellings, constructed of woven tules, which could house a single family or as many as ten.

The rich estuarine and riverine resources provided by the local environment enabled a more sedentary existence than was typical of most California groups. Diet consisted largely of fish, waterfowl, shellfish, grass seeds, and tule roots. Most toolstone was imported, while other implements, such as arrow shafts or baskets, were made from tule reeds.

The first European contact with the South Valley Yokuts was in 1772, soon after the first Spanish settlement in California. The area was influenced only lightly by missionization: the difficult marshy terrain made it difficult to find either new converts or runaways from mission authority. It was only with the establishment of farms and ranches in the southern Valley after the Gold Rush that the South Valley Yokuts were dispossessed of their land. Today a small remnant of the group lives on the Tule River and Santa Rosa reservations (Wallace 1978).

***Foothill Yokuts***

The Foothill Yokuts are distinguished from their valley cousins both by their distinct dialects and their foothill habitat. Most Foothill Yokut villages were located between 2,000 and 4,000 feet in the Sierra Foothills, a zone that incorporates diverse life zones including chaparral, coniferous forest, and oak woodland. Their subsistence was focused on hunting and gathering and was highly diversified, with fish playing a much smaller part than in the valley. As in the valley, basketry and stone work were the major crafts, although some simple pottery is attested from central foothills groups (Wallace 1978). In the Friant Division, the Yokod group of Foothill Yokuts held territory near the town of Lindsay.

***Kitanemuk***

The southern half of the Arvin-Edison Water District in the Friant Division was home to the Kitanemuk, a small group of 500 to 1000 persons who spoke a Serran language in the Takic group of the Uto-Aztecan family. Little is known about the Kitanemuk. It is reported that they had good relations with their Chumash and Tubalatabal neighbors, while maintaining one of enmity with the Yokuts to the north. Essentially a mountain people, they utilized a mixed subsistence strategy, exploiting the oak savannah and perennial creeks of their mountain home. By 1900 the group had only a few members left.

***Native American Sites***

Native American habitation has left many traces on the landscape. The most intensive settlement was located along watercourses, of which the valley had many. In the north part of San Joaquin Valley numerous village sites were located on mounds on or near the natural levees that flank many parts of the

San Joaquin River. In the south valley, village sites have been discovered along the shores of the former Buena Vista and Tulare lakes, and more doubtless exist along other waterways. Village sites, often marked by a mound, are characterized by extensive subsurface deposits and sometimes contain human burials.

Other types of Native American sites include lithic surface scatters of lithic and other artifacts, which may indicate a temporary camp or specialized tool processing area. They also include many bedrock or boulder milling/food-processing stations, characterized by cupules and slicks in the rocks. These are often located at natural bedrock outcrops or along perennial streams that may deposit large boulders of suitable material along their course. Trails, rock art and isolated artifacts or flakes are other traces of Native American occupation that may be present in the project area.

***History***

The first Europeans to enter the Project Area were Pedro Fages and his expedition, who explored the San Joaquin Valley in 1772. However, most subsequent Spanish settlement in California was concentrated along the coast and adjacent valleys. When Mexico became independent, the government began to give land grants to settlers, including a few in the southern valley in the early 1830s. These settlements often provided the nucleus for present-day cities.

Until the late 1850s, the San Joaquin Valley was sparsely settled by Europeans. Extensive areas of marsh were a hindrance to farming. By the mid-1860s, however, settlers were beginning to reclaim and drain land for agriculture and ranching. By the 1870s, the San Joaquin Valley was the center of California's wheat production. The introduction of canning technology and transcontinental rail led to a widespread diversification and development of specialty crops such as fruits and nuts. About the same time, exploitation of the petroleum resources of the valley began, and continues today. The need for a steady supply of water to irrigate the increasing acreage of farmed land led to the incorporation of water districts, and in 1933 to the introduction of the State Water Plan, which grew into the Central Valley Project of the Bureau of Reclamation.

***Historic Sites***

The project area includes a large number of historic sites. The majority of these are within the confines of historic settlements such as Fresno and Madera. However, many other types of historic features may be found in the landscape, including but are not limited to, historic structures; linear features such as roads, trails, railroads, and telegraph lines; features related to historic water transportation, such as canals, ditches, and channels; and homesteads and ranch-related structures.

***Cultural Resources Baseline Data***

This section presents the results of record searches conducted at the Central California and Southern San Joaquin Valley Information Centers of the California Historical Resources Information System. A more detailed presentation is provided in the confidential technical appendix to this EA.

***Information Sources***

Because of the irregular boundaries of the various water districts encompassed in the Friant Division, the USGS 7.5' quadrangles with coverage of one or more Friant water districts were searched in their entirety. The information requested included:

- A list of recorded historic and prehistoric archaeological sites
- Archaeological sites reported to the Information Center, but not formally recorded
- The California Inventory of Historical Resources for the project counties
- California Points of Historical Interest within the project area
- The Directory of Properties in the Historic Properties Data File for the project counties, which includes all properties assessed for the National Register of Historic Places (NRHP) (through September 1999).
- The list of Archaeological Determinations of Eligibility, which includes archaeological sites assessed for inclusion in the NRHP, State, or local registries (through June 1999).

The NAHC also performed a search of its sacred lands file for the project area. Numerous sacred sites and other traditional cultural properties are located in or near the Friant Division and Cross-Valley Canal. However, specific information is confidential. Reclamation is currently conducting government-to-government contacts with federally recognized tribes who may have information about such sites.

***Data Limitations***

The data retrieved from the Information Centers carry number of limitations. Most significant is the fact that only a small percentage of California has been subjected to intensive archaeological survey. Estimated survey percentages for the counties of the Friant Division are as follows (Reclamation 1999 [p. II:42, II:50]):

- Fresno 5 percent
- Kern 5 percent
- Madera 1-2 percent
- Merced 2 percent
- Tulare 2 percent

Most archaeological surveys are project-driven; that is, they are conducted in response to a proposed change in land use or new ground-disturbing activity requiring agency review. Therefore, lists of known sites reflect the number of studies performed and do not necessarily reflect the actual density or distribution of archaeological sites. It is likely that the agricultural land that comprises most of the Friant Division service area has not undergone significant changes in land use that would trigger archaeological investigation. Therefore, it seems probable that even less of the land in the Friant Division has been surveyed than the above percentages would indicate.

It is likely that historic archaeological sites are under represented in the Information Center database, since the recording of historic archaeological sites was not common until the 1970s. In addition, the Information Center records may be incomplete because of a backlog in data entry or the failure of individuals or agencies to submit site records or reports. Such missing information is not reflected in the data presented below.

The data presented in the attached tables distinguish between historic resources that are part of the built environment and those that are archaeological in nature. For the purposes of this report, built environment resources include historic structures or features, such as canals or houses, that are still in use. Archaeological resources, on the other hand, were defined as historic features or structures that are no longer an active part of the built environment. Therefore, inhabited houses or working canals are included in the built environment of the tables, whereas abandoned houses or disused railroad grades are counted as historic archaeological resources.

***Search Results***

From the record search results, a database has been prepared that includes the information listed above. Because of the highly irregular boundaries of the water districts within the APE, sites were included in a 500 meter buffer zone outside of the apparent district boundaries to ensure complete coverage. Therefore, the number of sites listed below may slightly exceed those actually within the APE.

A total of 243 built environment or archaeological resources are listed within the Friant Division. Of these, 140 (57.6%) are prehistoric archaeological sites; 19 (7.8%) are historic archaeological sites; five (2.1%) have both prehistoric and historic archaeological components; 79 (32.5%) are part of the built environment (Table CR-1).

**Table CR-1**
**Cultural Resources in the Friant Division**

| District | Prehistoric Sites | Historic Sites | Multicomponent sites | Built Environment | Total |
|---|---|---|---|---|---|
| Arvin-Edison Water Storage District | 5 | 1 | | 6 | **12** |
| Chowchilla Water District | 9 | | | 5 | **14** |
| City of Lindsay | | | | 2 | **2** |
| City of Orange Cove | 1 | | | 1 | **2** |
| Delano-Earlimart Irrigation District | | | | 1 | **1** |
| Exeter Irrigation District | 16 | | | 6 | **22** |
| Fresno County Water Works #18 | 5 | 3 | 1 | | **9** |
| Fresno Irrigation District | 25 | 3 | 1 | 16 | **45** |
| Garfield Water District | 1 | | | | **1** |
| Gravelly Ford Water District | 2 | | | | **2** |
| International Water District | 1 | | 1 | | **2** |
| Ivanhoe Irrigation District | 3 | | | | **3** |
| Lindmore Irrigation District | | | | 1 | **1** |
| Lindsay-Strathmore Irrigation District | 6 | | | | **6** |
| Lower Tule River Irrigation District | 8 | | | 5 | **13** |
| Madera Irrigation District | 19 | 6 | 1 | 7 | **33** |
| Orange Cove Irrigation District | 13 | 1 | 1 | | **15** |
| Shafter-Wasco Irrigation District | 2 | 3 | | 4 | **9** |
| South San Joaquin MUD | 1 | 0 | | 2 | **3** |
| Stone Corral Irrigation District | 3 | | | | **3** |
| Tea Pot Dome Water District | 3 | | | | **3** |

**Table CR-1**
**Cultural Resources in the Friant Division**

| District | Prehistoric Sites | Historic Sites | Multicomponent sites | Built Environment | Total |
|---|---|---|---|---|---|
| Terra Bella Irrigation District | 11 | | | | **11** |
| Tulare Irrigation District | 6 | 2 | | 23 | **31** |
| **Totals for Friant Division** | **140** | **19** | **5** | **79** | **243** |

Source: California Historical Resources Information System 1999

A majority of the built environment resources (45, 57.7%) are located in the Fresno, Madera, and Tulare water districts, which are predominantly urban. Twenty-one built environment resources in the Friant Division are listed on the NRHP or the California Register of Historic Resources (CRHC). Fourteen historic bridges are listed on the Historic American Building Survey/Historic American Engineering Register (HABS/HAER). Beyond this, 31 historic properties and 4 prehistoric sites in the Friant Division have been determined eligible for the NRHP or CRHR. Of the remaining known resources, five have been determined ineligible for NHRP or CRHR and the rest are unassessed or of unknown status (Table CR-3, CR-4).

**Table CR-2**
**Prehistoric Archaeological Resources and Register Status**

| District | NRHP/CRHR eligible | Not NRHP/ CRHR eligible | Unevaluated/ status unknown | Total |
|---|---|---|---|---|
| Arvin-Edison Water District | | | 5 | **5** |
| Chowchilla Water District | | | 9 | **9** |
| City of Lindsay | | | | **0** |
| City of Orange Cove | | | 1 | **1** |
| Delano-Earlimart Irrigation District | | | | **0** |
| Exeter Irrigation District | | | 16 | **16** |
| Fresno County Water Works #18* | | | 6 | **6** |
| Fresno Irrigation District* | 3 | | 23 | **26** |
| Garfield Water District | | | 1 | **1** |
| Gravelly Ford Water District | | | 2 | **2** |
| International Water District* | | | 2 | **2** |
| Ivanhoe Irrigation District | | | 3 | **3** |
| Lindsay-Strathmore Irrigation District | 1 | 1 | 4 | **6** |
| Lower Tule River Irrigation District | | | 8 | **8** |
| Madera Irrigation District* | | | 20 | **20** |
| Orange Cove Irrigation District* | 1 | | 13 | **14** |
| Shafter-Wasco Irrigation District | | | 2 | **2** |
| South San Joaquin MUD | | | 1 | **1** |
| Stone Corral Irrigation District | | | 3 | **3** |
| Tea Pot Dome Water District | | | 3 | **3** |
| Terra Bella Irrigation District | | | 11 | **11** |
| Tulare Irrigation District | | | 6 | **6** |
| **Total** | **5** | **1** | **139** | **145** |

Source: California Historical Resources Information System 1999

Note: * One multicomponent site which is counted on both historic and prehistoric tables.

**Table CR-3**
**Built Environment Resources and Register Status**

| District | NRHP or other register | NRHP/ CRHR eligible | Not NRHP eligible | Unevaluated/ status unknown | Not eligible but HABS/HAER listed | Total |
|---|---|---|---|---|---|---|
| Arvin-Edison Water District | 3 | | | 3 | | **6** |
| Chowchilla Water District | 1 | 1 | | | 3 | **5** |
| City of Lindsay | | 2 | | | | **2** |
| City of Orange Cove | 1 | | | | | **1** |
| Delano-Earlimart Irrigation District | | | | | 1 | **1** |
| Exeter Irrigation District | 1 | 1 | | 1 | 3 | **6** |
| Fresno Irrigation District | 8 | 5 | | 2 | | **15** |
| Lindmore Irrigation District | 1 | | | | | **1** |
| Lower Tule River Irrigation District | | | 1 | 4 | | **5** |
| Madera Irrigation District | 1 | 1 | | | 5 | **7** |
| Shafter-Wasco Irrigation District | 4 | | | | | **4** |
| South San Joaquin MUD | | 1 | | 1 | | **2** |
| Tulare Irrigation District | 1 | 16 | | 4 | 2 | **23** |
| **Total** | **21** | **27** | **1** | **15** | **14** | **78** |

Source: California Historical Resources Information System 1999

The 25 historic archaeological sites in the Friant Division constitute too small a sample to make meaningful generalizations about. Madera Irrigation District has the most such sites, with 7 (28%). The districts with the most prehistoric archaeological resources are Exeter (16, 11 % of all prehistoric sites), Fresno (26, 17.9%), Madera (20, 13.8%), and Orange Cove (13, 9.7%). These four districts comprise 52% of the total prehistoric sites. However, the relative abundance of sites within these districts may be a product of survey intensity rather than the actual distribution of sites across the landscape ( Table CR-2, CR-3).

**Table CR-4**
**Historical Archaeological Resources and Register Status**

| District | Not NRHP/CRHR eligible | Unevaluated/ status unknown | Total |
|---|---|---|---|
| Arvin-Edison Water Storage District | | 2 | **2** |
| Fresno County Water Works #18* | 1 | 3 | **4** |
| Fresno Irrigation District* | | 4 | **4** |
| International Water District* | | 1 | **1** |
| Madera Irrigation District* | | 7 | **7** |
| Orange Cove Irrigation District* | | 2 | **2** |
| Shafter-Wasco Irrigation District | 1 | 2 | **3** |
| Tulare Irrigation District | | 2 | **2** |
| **Total** | **2** | **23** | **25** |

Source: California Historical Resources Information System 1999
Note:
* One multi-component site which is counted on both historic and prehistoric tables.

***Regulatory Setting***

For federal purposes, a historic property is a cultural resource that is significant under the criteria of eligibility for the NRHP, as defined under 36 Code of Federal Regulations (CFR) 60.4. Historic properties must possess integrity of location, design, workmanship, feeling, and association and must meet at least one of the following criteria:

- Association with events that have made significant contributions to the broad patterns of the U.S. history.
- Association with the lives of people significant in U.S. history.
- Embody the distinctive characteristics of a type, period, or method of construction; or represent the work of a master, or possess high artistic value, or represent a significant and distinguishable entity whose components may lack individual distinction.
- Has yielded, or is likely to yield, information important in history.

California State Landmarks are assigned a sequential number as they are identified and compiled. Landmarks above number 770 are automatically included in the CRHR while landmarks below number 770 require individual evaluation for inclusion on the CRHR or NRHP.

Section 15064.5 of CEQA also assigns special importance to the physical remains of Native Americans and specifies procedures to be used when human remains are discovered. These procedures are spelled out under PRC 5097.98. Criteria for eligibility for the CRHR are very similar to those (detailed below) which qualify a property for the NRHP, under the National Historic Preservation Act (NHPA). Note that a property that is eligible for the NRHP is also eligible to the CRHR.

Impacts to “unique archaeological resources” are also considered under the California Environmental Quality Act (CEQA), as described under PRC 21083.2. Unique archaeological resources include archaeological artifacts, objects, or sites. Without merely adding to the current body of knowledge, these resources must have a high probability of meeting one of the following criteria:

- Contains information needed to answer important scientific questions and there is a demonstrable public interest in that information.
- Has a special and particular quality, such as being the oldest of its type or the best available example of its type.
- Is directly associated with a scientifically recognized important prehistoric or historic resources.

CEQA/CRHR criteria parallel those of the NRHP, but emphasize significance to California culture and history, and also permit listing of properties which may not qualify for the NRHP, but which have particular significance to the local community.

## Environmental Consequences

This section describes the basis for:

- Determining which cultural resources located within the project area have been included or are considered eligible for inclusion on the NHRP or significant in accordance with CEQA, and whether additional such resources may remain undiscovered within the water service areas encompassed by the Friant Division.
- Identifying and assessing the potential effects of the contract renewal alternatives under consideration on eligible or potentially eligible or significant cultural resources.
- Outlining appropriate measures that can be taken to avoid, minimize, or mitigate adverse impacts to any eligible cultural properties that could be affected by the undertaking.

### *No Action Alternative*

The NAA serves as a baseline for comparison with the other alternatives in the EA. It describes the conditions in the absence of a federal project. Developed from the PEIS Preferred Alternative, the NAA assumes existing CVP facilities in the Friant Division would continue to be managed as at present. The NAA uses the full contract amount from the previous year. This contract amount does not change whether the contractor takes the water or not, only the quantity available in a given year. Changes to the management direction could affect operations of the CVP water facilities, repayment methods and pricing structures for water and power, water contract renewals, and compliance with federal and state water quality requirements.

Because the NAA assumes renewal of the long-term contracts, it would, thus, be considered a federal undertaking. Continued delivery of Friant Division water would constitute a project with potential for adverse environmental effects pursuant to NEPA.

Impacts could occur due to plowing or trenching through an archaeological site, leveling of a mound, and repeated changes in reservoir impoundment levels, which could result in increased surficial erosion that could expose previously buried sites.

The many archaeological sites within the Friant Division include documented and undocumented prehistoric and historic sites and features, and groups of sites that may qualify as NRHP. As well as visible surface manifestations, these sites may include or be primarily composed of subsurface accumulations of cultural material. The importance of such a site, therefore, rests not only on the age and materials present but also on the horizontal and vertical integrity of the soil and its contents.

Under the NAA, all existing Friant Unit management will continue as under existing conditions. No significant impacts to cultural resources are expected, since no additional infrastructure (i.e. dams, increase in dam heights, canals, etc.) will be constructed. Additionally, under this alternative, there will be no increase in deliveries and no conversion of existing natural habitat into farmland or other uses.

In those LTCR actions that are not within the range of existing conditions and will affect historic properties, a commitment will be made that Reclamation will comply with Section 106 of the National Historic Preservation Act. In some instances the responsibility to address affects to cultural resources will be with the local government as part of their CEQA compliance for their actions. Such actions are approved locally and at the state level. Reclamation would need to consider the effects to historic properties when Reclamation approves new lands being brought into an irrigation district (Inclusions) and when Reclamation approves a change in use that could lead to an effect on a historic property.

In compliance with 36 CFR 800.4(a) (4), Reclamation has sent letters to Indian tribes requesting their input regarding the identification of any properties to which they might attach religious and cultural significance to within the area of potential effect. To date no comments or formal responses have been received from the tribes.

***Alternative 1***

Alternative 1 is similar to the NAA. Therefore, there are no significant impacts to cultural resources under this alternative.

***Alternative 2***

Alternative 2 is similar to the NAA. Therefore, there are no significant impacts to cultural resources under this alternative.

**Cumulative Effects**

Under all three Alternatives, all Friant Division management will continue to operate as at present. No changes in land use will be created by the project, therefore, implementation of Alternative 1 or 2 would not contribute to cumulative effects on cultural resources.

## SOCIAL CONDITIONS

### Affected Environment

The social conditions in the Friant Division service area are described with factors such as employment level, educational opportunities, the income level, the community social structure, and the need for public social assistance programs. These conditions were described in detail for the San Joaquin River Region and the Tulare Lake Region in the PEIS and are summarized below.

The Friant Division service area is predominately rural with numerous small cities. Large communities, such as Fresno and Bakersfield are also located in the Friant Division service area . The regional economic indicators of social well being are measures of the social conditions within a region. For the southern San Joaquin Valley the indicators show the unemployment rate is higher than in urban areas (Table SC-1), attributed to a large seasonal labor market and limited availability of employment in other industries. Unemployment for Fresno, Kern, Tulare, Merced, and Madera counties ranged from 12.1 to 15.6 % in 1997 while statewide unemployment was 6.3 % (see Table SE-1). As the farming economy declines, employment opportunities also decline.

**Table SC-1**
**Regional Demographic and Economic Indicators of Social Well Being**

| Issues | San Joaquin River Region | Tulare Lake Region |
|---|---|---|
| Population in 1992 | 2,022,000 | 1,031,000 |
| Median Family Income in 1990 | $29,000 to $35,000 | $37,000 - $32,000 |
| Per Capita Income in 1990 | $11,000 to $13,000 | $10,000 to $12,000 |
| Poverty Rate in 1990 | 9% to 21% | 17% to 23% |
| Median House Costs in 1990 | $100,000 | $80,000 |
| Unemployment Rate in 1992 | 11% to 17% | 15% |

Source: EDD 1999

The ethnicity of the Friant Division service area  is predominately white with Hispanic peoples occupying about 30% of the population in both the San Joaquin and Tulare Lake regions (Table SC-2). The statewide estimates for poverty and unemployment levels within these ethnic groups are shown in Table SC-3.

**Table SC-2**
**Ethnicity in Regions**

| Ethnicity | San Joaquin River Region (percentage) | Tulare Lake Region (percentage) |
|---|---|---|
| White | 58 | 60 |
| Black | 4 | 4 |
| Asian | 8 | 3 |
| Hispanic | 29 | 33 |

Source: EDD 1999

**Table SC-3**
**Statewide Poverty and Unemployment Rates**

| Ethnicity | Poverty Rate (percentage) | Unemployment Rate (percentage) |
|---|---|---|
| White | 6 | 4 |
| Black | 21 | 7 |
| Asian | 11 | 4 |
| Hispanic | 18 | 7 |

Source: EDD 1999

The largest employment opportunity in the region is agricultural.  Agricultural employment affects local communities not only as direct labor (farmers, farm workers) but also indirectly through farm equipment, farm supplies, and farm commodity processing.

Within the Friant Division service area are two major social groups: farmers, and farm and agribusiness workers (EDD 1999).  Farmers are individuals who own farmland or manage farm operations.  Typically, farmers live within 15 miles of the farm and spend about 85% of farm production costs locally (EDD

1999). Farm workers are people employed to work on a farm, including permanent and seasonal workers. The San Joaquin River Region contains crops such as citrus and grapes and therefore the region tends to be the most labor intensive region of the CVP (EDD 1999). About 41% of the farm workers are seasonal employees. Agribusiness workers are those individuals who are indirectly involved with farm production and employed in businesses that serve the farming community. In 1999, 18.3 to 19% of the civilian labor force were employed in agriculture in Fresno, Kern, and Merced counties. Agriculture accounts for 27 to 29.9% of total employment in Tulare and Madera counties (EDD 1999).

## Environmental Consequences

### *Environmental Justice*

Executive Order 12898 requires that federal agencies address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the U.S. and its territories. This action would not have a disproportionately high adverse affect on any one ethnic group more than another, including land owners, farmers, and farm workers. However, this action would reflect more on the individual education and skill level and the type of labor requirements necessary for the agricultural production and services, notably there could be indirect impacts to farm laborers who are generally economically disadvantaged (Reclamation 1999a).

### *No Action Alternative*

Under the NAA, all existing Friant Division management will continue to operate under current conditions. No new or additional CVP facilities will be constructed. Unemployment in the Friant Division service area will remain higher than the statewide unemployment rate. Agriculture will remain a large employer in the regions.

### *Alternative 1*

Impacts to social conditions associated with the Alternative 1 are expected to have similar effects to social conditions as the NAA. Therefore, there are no environmental impacts from this alternative.

### *Alternative 2*

The maximum reduction in irrigated acres was identified in an economic analysis using the wet water year following a 5-year sequence of dry years scenario (CH2M Hill 2000). Under this scenario, the economic analysis identified a reduction of less than 1% of irrigated acres in the Friant Division. This reduction in irrigated acreage would result in no impact to the Friant Division service area.

## Cumulative Effects

Implementation of Alternative 1 or 2 would not have an impact to social conditions. Therefore, the alternatives would not contribute to the cumulative effects of social conditions.

# AIR QUALITY

## Affected Environment

The Friant Division is within the San Joaquin Valley Air Basin. Comprising about 24,840 square miles, the air basin represents approximately 16 % of the geographic area of California and is the second largest air basin in California with an estimated 2.9 million persons. Major urban centers in the air basin include Bakersfield, Fresno, Modesto, and Stockton.

Air quality is regulated through both federal and California AAQSs. Federal AAQS establish primary and secondary national ambient air quality standards (NAAQS). National primary standards define air quality levels that are protective of public health while the secondary standards are protective of the public welfare (e.g., degrade the environment, impair visibility, damage vegetation and property). The potential impacts to these national and state AAQSs from implementation of the CVPIA are discussed and evaluated in the PEIS. However, the PEIS does suggest local regional conditions may require further evaluation. Consequently, the air quality assessment tiers off the PEIS by focusing on regional particulate emissions associated with renewal of contracts in the Friant Division.

In 1987, the national AAQS established fine particulate matter less than or equal to 10 microns ($PM_{10}$) at 150 micrograms per cubic meter ($\mu/m^3$) of air during a 24-hour period and 50 $\mu g/m^3$ on an annual basis. In 1997, $PM_{2.5}$ standards were promulgated by the EPA. As a subset of $PM_{10}$, $PM_{2.5}$ are particles with an aerodynamic diameter less than or equal to a nominal 2.5 microns. The $PM_{2.5}$ 24-hour and annual arithmetic standards are 65 and 15 $\mu g/m^3$, respectively.

By contrast, the California 24-hour and annual average standards are considerably more stringent than the federal 24-hour standards. The state standard is 50 $\mu g/m^3$ on a 24-hour basis while the annual geometric standard is 30 $\mu g/m^3$. Air basins that exceeded these values were determined to be nonattainment areas for $PM_{10}$. The EPA classified the San Joaquin Valley Air Basin as a serious $PM_{10}$ nonattainment area effective February 8, 1993. The San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) is currently implementing a $PM_{10}$ attainment plan to meet the federal standard (SJVUAPCD 1994).

The San Joaquin Valley Air Basin Mediterranean-like climate generally consists of hot dry summers and cool wet winters. Approximately 90 % of the rainfall occurs between November and April, with little or no precipitation occurring from late spring to early fall. The San Joaquin valley floor is characterized by hot, dry summers and cooler winters. The average mean temperature over a 30-year period is 65°F. High daily temperature readings in summer average 95°F in the valley. The valley also experiences mild winters; the winter average daily low temperature is 45°F. Over the last 30 years, the valley averaged 106 days a year 90°F or hotter, and 40 days a year 100°F or hotter. The daily summer temperature variation can exceed 30°F. The valley has an "inland Mediterranean" climate, averaging over 260 sunny days per year.

Semipermanent systems of high barometric pressure fronts frequently establish themselves over the Air Basin, deflecting low pressure systems that might otherwise bring cleansing rain and winds. The strength and duration of the inversion determines the amount of atmospheric mixing that will occur, which subsequently contributes to $PM_{10}$ concentrations in the Air Basin. Low wind speeds, combined with low inversion layers in the winter, create a climate conducive to high $PM_{10}$ concentrations (SJVUAPCD 1994).

## Environmental Consequences

Particulate sources that could be affected by contract renewals relate to dust sources associated with retirement and fallowing of agricultural land, the use of heavy farm equipment, and application of pesticides and fertilizers.

***No Action Alternative***

Under the NAA, the renewal of the contract would not involve the construction of any new facilities or result in land-disturbing activities that could contribute to particulate emissions or construction equipment exhaust.

Continued water supply deliveries will support both existing and future urban and agricultural land uses. These land uses do contribute to air pollutants, including emissions of reactive organic gases creating ozone, particulates, and other pollutants. The pollutant emission volumes and rates from these land uses is not expected to vary between the NAA and the alternatives.

In the NAA, agricultural land uses in the Central Valley would include similar crops and cropping patterns. It is assumed that retired or fallowed lands would be reseeded with grasses and grazed by livestock or occasionally dryland farmed. These cultivation measures are similar to methods used on lands that have been historically fallowed due to crop rotation or periodic cropping pattern changes.

The current policies and practices of regulatory agencies would continue at the present level of intensity. This would include the continuation of air quality monitoring and air quality compliance programs within the air district. Particulate emission programs targeting $PM_{10}$ from general and specific emissions sources in past years, are associated with reductions of $PM_{10}$ in the Central Valley. However, it is recognized that this region is in nonattainment for particulates and further efforts to reduce particulate emissions in the future is most likely to occur. Because the cultivated and fallowed acreage patterns are similar to historical patterns, it is anticipated that air quality under the NAA would be similar to recent conditions described in the Affected Environment.

***Alternative 1***

Irrigated acreage under Alternative 1 would be similar to the NAA. It is assumed that the lands to be retired or fallowed would go to seed with grasses and would be grazed by livestock or occasionally dryland farmed. These cultivation measures are similar to methods used on lands that have been historically fallowed due to crop rotation or periodic cropping pattern changes. Due to limited changes in land use it is anticipated that the level of wind erosion potential would not increase under Alternative 1 as compared to the NAA.

The retirement and fallowing of land would also be associated with reductions in the use of farm equipment and applications of pesticides and fertilizers. Because the percentage of land that would be affected by these changes is small, it is anticipated that air quality conditions resulting from vehicle emissions and pesticide and fertilizer use would not change under Alternative 1 as compared to the NAA.

***Alternative 2***

There is no impact to the overall reduction in irrigated acreage as compared to the NAA under Alternative 2. The maximum reduction in irrigated acres was identified in an economic analysis using the wet water year following a 5-year sequence of dry years scenario (CH2M Hill 2000). Under this scenario, the economic analysis identified a reduction of less than 1% of the irrigated acres in the Friant Division.

It is assumed that the lands to be retired or fallowed would go to seed with grasses and grazed by livestock or occasionally dryland farmed. These cultivation measures are similar to methods used on lands that have been historically fallowed due to crop rotation or periodic cropping pattern changes. Due to relatively minor changes in land use, it is anticipated that the level of regional wind erosion potential would not increase under Alternative 2 as compared to the NAA.

The retirement and fallowing of land would also be associated with reductions in the use of farm equipment and applications of pesticides and fertilizers. Because the percentage of land that would be affected by these changes is small, it is anticipated that air quality conditions resulting from vehicle emissions and pesticide and fertilizer use would not change under Alternative 2 as compared to the NAA.

### Cumulative Effects

Friant Division management will continue with no impact to the existing air quality. Implementation of Alternative 1 or 2 would not impact air quality. Therefore, the alternatives would not contribute to cumulative impacts on air quality.

## GEOLOGY AND SOILS

### Affected Environment

The Friant Division occupies the Sierra Nevada foothills and the southern San Joaquin Valley. The geology and soils impact analysis is primarily based upon soil erosion impacts from changes in agricultural land use and stream flows. A brief discussion of soils of the San Joaquin Valley and Sierra Nevada foothills is provided to describe the affected environment.

The Sierra Nevada is the tallest and most continuous mountain range in California. In the southern Sierra Nevada, elevations range from about 400 feet at the edge of San Joaquin Valley to 14,000 feet or more at the crest. The Sierra Nevada Province is generally composed of Mesozoic Sierran granitic batholith and associated older metamorphic rocks. The shallow soils of the lower Sierra Nevada foothills are moderately deep to deep to an elevation of about 3,500 feet. The gently rolling to steep foothills surface layer ranges from coarse sandy loam to clay with a high percentages of clean, well sorted gravel and sand. In general, alluvial sediments of the western and southern parts of the valley have lower permeability than eastside deposits (USDA 1971).

The San Joaquin Valley is composed of tertiary sediments and volcanics. The alluvial fans and plains consist of unconsolidated continental deposits that extend from the edges of the valley toward the center. Derived entirely from runoff from the Sierra Nevada, the alluvial material formed a level to rolling landscape. Soils formed in light to moderately coarse textured alluvium are derived from weathered granitic and sedimentary rock. The alluvial plains cover most of the valley floor and make up some of the intensely developed agricultural lands. The level to gently sloping soils of the valley surface layer range from sandy loam to clay. The valley soils are very deep to moderately deep and are well drained (USDA 1982).

Local wind velocities, climatic factor, soil surface roughness, width of field, and quantity of vegetative cover affect wind erosion of soils. The climatic factor incorporates the moisture of the surface soil. Soil taken out of irrigation and allowed to remain barren with no cover vegetation will have greater losses to wind erosion than the same soils under a good crop and land management program with irrigation. Wind erosion not only impacts vegetation but also public health through fugitive particulate emissions. Soil may become shallower, organic matter and needed plant nutrients could be removed, and young plants damaged by erosion and wind-borne particulates.

Several types of water-based soil erosion exist. In order of increasing erodibility they are sheet, splash, and rill and gully erosion. Some factors that influence the erodibility of soils include land slope, surface texture and structure, infiltration rate, permeability, particle size, and the presence of organic or other cementing materials. Level land erodes less than sloped land because flow velocities are less. Based on this factor alone, terrace and upland soils would be more susceptible to water erosion than soils on the valley floor.

## Environmental Consequences

Impacts on soil resources are considered if the project results in changes in agricultural land use which may result in increased erosion potential, which may result in increased bank erosion and associated siltation problems, land subsidence from ground water overdraft, and/or decreases in soil quality due to salt accumulation.

### *No Action Alternative*

Water supplies to lands within the Friant Division would be delivered to the contractors in accordance with the CVPIA and the individual long-term service contracts. All the alternatives would provide water supplies to the contracting agencies for their respective contract amounts. In the case of agricultural water deliveries, the continued delivery of CVP water would continue the productive use of prime farmlands that are found in the service area.

Retired or fallowed lands are assumed to have cover crop planted in the last year of cultivation. The existing policies and programs of Reclamation, as expressed in the CVPIA, provide for protection and conservation of unique soil, mineral, and geologic resources within the service contract area. These plans guide future land and resource uses within the CVP service area.

Increased river releases would be in accordance with the CVP operational criteria which include stream flow limitations to protect aquatic species and prevent scouring and bank erosion. Reclamation coordinates the operation of CVP reservoirs with the California Department of Fish and Game and the Service to schedule releases that create pulse flows to help “push” the fish downstream.

Based on the conjunctive use design of the Friant system, increased ground water use is very likely. Potential adverse effects associated with increased ground water usage include changes to the chemical composition of agricultural runoff, decreases in soil quality due to salt accumulation, diminution of ground water elevations, soil subsidence, and reduced ground water quality. It is assumed that the Contractors will return to greater use of Friant water at the conclusion of the dry period. This should allow the ground water table to recharge, diminish land subsidence, and reduce salt accumulations in the soil.

***Alternative 1***

Impacts to soil and geology associated with Alternative 1 are expected to have similar impacts as the NAA. Streamflow considerations will be applied in reservoir operations and will not increase streambed erosion.

***Alternative 2***

Reductions to the overall irrigated acreage as compared to the NAA under Alternative 2 would be minor. The maximum reduction in irrigated acres was identified in an economic analysis using the wet water year follow a 5-year sequence of dry years scenario (CH2M Hill 2000). Under this scenario, the economic analysis identified a reduction of less than 1% of the irrigated acres in the Friant Division.

Increased river releases would be in accordance with the CVP operational criteria which include steam flow limitations to protect aquatic species and prevent scouring and bank erosion. Reclamation coordinates the operation of CVP reservoirs with DFG and the Service to schedule releases that create pulse flows to help move fish downstream. Continued application of stream flow considerations in reservoir operations will avoid additional streambed erosion and adverse impacts on fish.

Retired or fallowed agricultural lands are assumed to have a cover crop planted in the last year of cultivation. The cultivation measures and future land use changes are not anticipated to increase the level of erosion as compared to the NAA. Stream flow considerations will be applied in reservoir operations and will not increase streambed erosion.

In the water needs assessment, it was predicted that in drought cycles it is likely that ground water aquifers throughout the Friant Division will experience drawdown while in a wet year following a five-year average period, the ground water pumping decreases (see Ground Water Resources Section). The effects of long-term increases and decreases in ground water pumping is unknown because water users may respond differently than predicted in the model.

## Cumulative Effects

Management of the Friant Division will continue with no impacts compared to the existing conditions. Implementation of Alternative 1 or 2 would not contribute to the cumulative impacts on geology or soils.

## VISUAL RESOURCES

### Affected Environment

The focus in the Friant Division are visual resources located at H.V. Eastman Lake, Hensley Lake, and Millerton Lake. Consideration was given to the CVP lakes, dams, and the associated canals (i.e., Chowchilla Bypass, Madera, Friant-Kern).

Visual resource classification is provided using the U.S. Forest Service (USFS) landscape character types and the Visual Management System. Landscape character types are based on landscapes with similar physiographies (i.e., combinations of landforms), vegetative cover, and surface water bodies. Based on its total visual character; no single physical characteristic dictates character type, although landform has a stronger influence than other characteristics. The USFS has established criteria for application of VMS to most landscape features occurring in the State of California (USFS, 1976). Landscape character is rated as follows:

- Variety Class A Landscapes are distinctive landscapes with high visual quality. They contain outstanding feature attractions and distinctive variety in form, line, color, texture, landform, vegetation, and water features. As a rule, Class A landscapes are favored by photographers.

- Variety Class B Landscapes are quality landscapes with some variety in form, line, color, or texture. Major visually dominant features are absent. In general, such landscapes are considered pleasant to view, but are not notably the subject of photographers.

- Variety Class C Landscapes are low quality visual landscapes. They are sometimes described as monotonous because they lack variety of form, line, color, and/or texture.

The VMS evaluates relationships among landforms, vegetation, water, air, and man-made structures. The quality of a landscape scene is evaluated using the following criteria: landscape character (based on the public perception of the view), visual sensitivity (based on the proximity of the viewer to the viewshed), and deviations from the characteristic landscape (based on the presence and design of manmade alterations to the landscape). Man-made alterations that borrow from the character of the landscape are considered more harmonious than those that do not borrow their form, line, color, and texture from the surrounding area (USFS 1973).

The San Joaquin River and Tulare Lake Regions include two provinces: the Sierra Foothills and Low Coastal Mountain and the Central Valley. Principal CVP facilities in the eastern portions of the San Joaquin River Region include the Friant Division consisting of Millerton Lake and the Friant-Kern and Madera Canals. The lakes are located in the Sierra Foothills Province. These areas are considered Variety Class B. Viewer sensitivity is high for these reservoirs with retention and preservation areas which support recreational facilities.

The Friant-Kern and Madera Canals offer relatively few road travel viewing opportunities. The canals enhance the visual interest of the landscapes in which they occur, but the flat land and land uses prevent frequent viewing by travelers on major routes. The service area is predominantly considered Variety

Class C, with extensive areas of monotonous landscape. The management standard is maximum modification or modification. Exceptions are those areas where the foothills join the Central Valley to form entrant valleys of agricultural land surrounded by grass-covered and wooded hills, which are considered Variety Class B. The management standard is maximum modification and/or modification. Urban areas are considered Variety Class C, with management standards of maximum modification and/or modification.

## Environmental Consequences

Impacts to visual resources are dependent upon (1) changes in cropping patterns, which may result in increased fallowed lands and associated modified agricultural viewshed, and (2) releases from storage reservoirs, which may result in a "bathtub ring" caused by the appearance of unvegetated soil at the shoreline between the water surface and the high water line.

### *No Action Alternative*

Under the NAA, all existing Friant Division management practices and operations will continue as in existing conditions. Retired or fallowed agricultural lands are assumed to have cover crops planted in the last year of cultivation. Cultivated and fallowed acreage patterns would be similar to historic patterns.

### *Alternative 1*

Alternative 1 does not involve the construction of any new facilities or result in land-disturbing activities that could alter the visual environment. Cultivated and fallowed acreage patterns would be similar to historic patterns. Alternative 1 would have similar effects to the resources as the NAA. Therefore, there are no impacts from this alternative.

### *Alternative 2*

The maximum reduction in irrigated acres was identified in an economic analysis using the wet water year following a 5-year sequence of dry years scenario (CH2M Hill 2000). Under this scenario, the economic analysis identified a reduction of less than 1% of the irrigated acres in the Friant Division.

Additionally, retired or fallowed agricultural production lands are assumed to have cover crops planted in the last year of cultivation. Little change would occur in the agricultural viewshed under Alternative 2 in comparison with the NAA.

## Cumulative Effects

Management of the Friant Division will continue with no impacts to the visual resources. Implementation of Alternative 1 or 2 would not contribute to the cumulative impacts on visual resources.

SECTION 4
# CONSULTATION AND COORDINATION

## INTRODUCTION

Prior to preparation of this EA, input was solicited and incorporated from a broad range of cooperating and consulting agencies and the public. This section summarizes the public involvement program and key issues raised by the public and interest groups. This section also addresses the manner in which Federal statutes, implementing regulations, and executive orders potentially applicable to implementation of the CVPIA have been addressed. The conclusions of compliance are based on the Environmental Consequences presented in Section 3. The compliance summaries apply only to the alternatives discussed in this EA and not the development of concurrent CVPIA implementation programs.

## PUBLIC INVOLVEMENT

Reclamation started the preparation of this EA with Scoping Meetings. Scoping served as a fact-finding process to identify public concerns and recommendations about the long-term contract renewal issues that would be addressed in this EA and the scope and level of detail for analyses. Scoping activities began in October 1998 after a Notice of Intent to prepare environmental documentation for long-term contract renewals was filed in the Federal Register. The scoping period formally ended in January 1999. The Scoping Report was released in summer of 1999.

Public input continued during long-term contract negotiations to define the contract language. Discussions also were held with the San Felipe Division long-term water service contractors during the preparation of this document.

At public scoping meetings, Reclamation provided information about long-term contract renewal process and solicited public comments, questions, and concerns. At these meetings, participants had numerous comments and questions about how important issues would be considered both in the PEIS and the long-term contract renewal process. The majority of the comments received during the Scoping process addressed the Needs Assessment methodology to be used as part of the long-term contract renewal process. Contract renewal negotiation issues also were addressed. The least number of comments addressed environmental review issues.

Reclamation received numerous comments about issues to be considered in the PEIS and methodologies for analyzing impacts. Comments considering the development of alternatives were considered in the formation of the alternatives. However, it was determined to focus the description of alternatives on the contract proposals and address issues related to water supply improvements to be addressed by CALFED and the Least Cost Yield study. Consideration of comments on methods to address impacts were considered in the development of the Environmental Consequences section of this EA. However, the impact analysis focused on the comparison of the alternatives with the projected NAA not the Existing Conditions scenario.

Based upon the comments received and the determination to focus the alternatives on the language in the proposed contracts, the level of detail for this EA was determined. It was also determined that based upon the minimal number of differences between Alternatives 1 and 2, an EIS would not be necessary.

## CONSULTATION WITH OTHER AGENCIES

This EA was prepared in accordance with the policies and regulations for the following issues. Brief discussions of these issues and how compliance was addressed in this EA is discussed in the previous sections. Work is continuing on each of these requirements. As individual projects are implemented, compliance requirements will be considered.

- National Environmental Policy Act
- California Environmental Quality Act
- Endangered Species Act
- Fish and Wildlife Coordination Act
- National Historic Preservation Act
- Indian Trust Assets
- Indian Sacred Sites on Federal Land
- Environmental Justice
- State, Area-wide, and Local Plan and Program Consistency
- Floodplain Management
- Wetlands Protection
- Wild and Scenic Rivers Act
- Farmland Protection Policy Act and Farmland Preservation
- Clean Air Act
- Safe Drinking Water Act
- Clean Water Act

### National Environmental Policy Act

This EA was prepared pursuant to regulations implementing the National Environmental Policy Act (NEPA) (42 USC 4321 *et seq.*). NEPA provides a commitment that Federal agencies will consider the environmental effects of their actions. This EA provides information regarding the NAA and alternatives, environmental impacts of the alternatives, potential mitigation measures, and adverse environmental impacts that cannot be avoided.

### California Environmental Quality Act

Implementation, funding and permitting actions carried out by State and local agencies must comply with the California Environmental Quality Act (CEQA). The CEQA requirements are similar to NEPA requirements. This EA could be used as a basis for preparation of a CEQA document.

## Fish and Wildlife Coordination Act

The FWCA requires that Reclamation consult with fish and wildlife agencies (federal and state) on all water development projects that could affect biological resources. The implementation of the CVPIA, of which this action is a part, has been jointly analyzed by Reclamation and the Service and is being jointly implemented. This continuous consultation and consideration of the views of the Service in addition to their review of this document and consideration of their comments satisfies any applicable requirements of the FWCA.

## Endangered Species Act

Reclamation is preparing a biological assessment to determine of alternatives will affected listed threatened and endangered species. The biological assessment addresses all species affected by the CVP operation for the Cross Valley Contractors. If the biological assessment indicates that the alternatives may affect a listed species, Reclamation will request formal consultation pursuant to the ESA.

## National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) requires that Federal agencies evaluate the effects of Federal undertakings on historical, archeological, and cultural resources and afford the Advisory Council on Historic Preservation opportunities to comment on the proposed undertaking. The first step in the process is to identify cultural resources included on (or eligible for inclusion on) the National Register of Historic Places that are located in or near the project area. The second step is to identify the possible effects of proposed actions. The lead agency must examine whether feasible alternatives exist that would avoid such effects. If an effect cannot reasonably be avoided, measures must be taken to minimize or mitigate potential adverse effects.

During preparation of this EA, information from the State Clearinghouse was collected. The counties within San Felipe Division have initiated separate consultations with respect to their land use planning activities. It was determined by the State Historic Preservation Office that compliance with Section 106 should be coordinated on a project-specific basis.

## Indian Trust Assets

The United States Government's trust responsibility for Indian resources requires Reclamation and other agencies to take measures to protect and maintain trust resources. These responsibilities include taking reasonable actions to preserve and restore tribal resources. Indian Trust Assets (ITAs) are legal interests in property and rights held in trust by the United States for Indian tribes or individuals. Indian reservations, rancherias, and allotments are common ITAs.

During preparation of EA, it was determined based upon information provided by Reclamation, that no ITAs exist within the San Felipe Division.

## Indian Sacred Sites on Federal Land

Executive Order 13007 provides that in managing Federal lands, each Federal agency with statutory or administrative responsibility for management of Federal lands shall, to the extent practicable and as permitted by law, accommodate access to and ceremonial use of Indian sacred sites by Indian religious practioners, and avoid adversely affecting the physical integrity of such sacred sites. No sacred sites were identified during the scoping or planning process, and therefore were not included in the impact assessment of this EA.

## Environmental Justice

Executive Order 12898 requires each Federal agency to achieve environmental justice as part of its mission, by identifying and addressing disproportionately high and adverse human health or environmental effects, including social or economic effects, of programs, policies, and activities on minority populations and low-income populations of the United States. This EA has evaluated the environmental, social, and economic impacts on minority and low-income populations in the impact assessment of alternatives.

## State, Area-wide, and Local Plan and Program Consistency

Agencies must consider the consistency of a proposed action with approved state and local plans and laws. This EA was prepared with extensive information from local planning agencies.

## Floodplain Management

If a Federal agency program will affect a floodplain, the agency must consider alternatives to avoid adverse effects in the flood plain or to minimize potential harm. Executive Order 11988 requires Federal agencies to evaluate the potential effects of any actions they might take in a floodplain and to ensure that planning, programs, and budget requests reflect consideration of flood hazards and floodplain management. The alternatives would not affect floodplain management as compared to the NAA.

## Wetlands Protection

Executive Order 11990 authorizes Federal agencies to take actions to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands when undertaking Federal activities and programs. Any agency considering a proposal that might affect wetlands must evaluate factors affecting wetland quality and survival. These factors should include the proposal’s effects on the public health, safety, and welfare due to modifications in water supply and water quality; maintenance of natural ecosystems and conservation of flora and fauna; and other recreational, scientific, and cultural uses. The alternatives would not affect wetlands as compared to the NAA.

## Wild and Scenic Rivers Act

The Wild and Scenic Rivers Act designates qualifying free-flowing river segments as wild, scenic, or recreational. The Act establishes requirements applicable to water resource projects affecting wild, scenic, or recreational rivers within the National Wild and Scenic Rivers System, as well as rivers designated on the National Rivers Inventory. Under the Act, a Federal agency may not assist the construction of a water resources project that would have a direct and adverse effect on the free-flowing, scenic, and natural values of a wild or scenic river. If the project would affect the free-flowing characteristics of a designated river or unreasonably diminish the scenic, recreational and fish and wildlife values present in the area, such activities should be undertaken in a manner that would minimize adverse impacts and should be developed in consultation with the National Park Service. None of the EA alternatives would affect flows in wild and scenic portions of rivers.

## Farmland Protection Policy Act and Farmland Preservation

Two policies require federal agencies to include assessments of the potential effects of a proposed project on prime and unique farmland. These policies are the Farmland Protection Policy Act of 1981 and the Memoranda on Farmland Preservation, dated August 30, 1976, and August 11, 1980, respectively, from the U.S. Council on Environmental Quality. Under requirements set forth in these policies, federal agencies must determine these effects before taking any action that could result in converting designated prime or unique farmland for nonagricultural purposes. If implementing a project would adversely affect farmland preservation, the agencies must consider alternatives to lessen those effects. Federal agencies also must ensure that their programs, to the extent practicable, are compatible with state, local, and private programs to protect farmland. The SCS is the federal agency responsible for ensuring that these laws and polices are followed. No specific consultation was conducted during preparation of this EA. The alternatives would not affect agricultural or urban lands as compared to the NAA.

## Clean Air Act

The Federal Clean Air Act (CAA) was enacted to protect and enhance the nation’s air quality in order to promote public health and welfare and the productive capacity of the nation’s population. The CAA requires an evaluation of any federal action to determine its potential impact on air quality in the project region. Coordination is required with the appropriate local air quality management district as well as with the EPA. This coordination would determine whether the project conforms to the Federal Implementation Plan and the State Implementation Plan (SIP).

Section 176 of the CAA (42 U.S.C. Section 7506(c)) prohibits federal agencies from engaging in or supporting in any way an action or activity that does not conform to an applicable SIP. Actions and activities must conform to a SIP’s purpose of eliminating or reducing the severity and number of violations of the national ambient air quality standards and in attaining those standards expeditiously. EPA promulgated conformity regulations (codified in 40 CFR Section 93.150 et seq.).

The alternatives assume that current practices to control dust and soil erosion on lands that are seasonally fallowed would continue and the land use agencies would continue to work with the air quality districts. Therefore, it assumed that no air quality impacts would occur due to the alternatives as compared to the NAA.

## Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) (PL 99-339) became law in 1974 and was reauthorized in 1986 and again in August 1996. Through the SDWA, Congress gave the EPA the authority to set standards for contaminants in drinking water supplies. Amendments to the SDWA provide more flexibility, more state responsibility, and more problem prevention approaches. The law changes the standard-setting procedure for drinking water and establishes a State Revolving Loan Fund to help public water systems improve their facilities and to ensure compliance with drinking water regulations and to support state drinking water program activities.

Under the SDWA provisions, the California Department of Health Services has the primary enforcement responsibility. The California Health and Safety Code establishes this authority and stipulates drinking water quality and monitoring standards. To maintain primacy, a state’s drinking water regulations cannot be less stringent than the federal standards. The analysis of the EA alternatives as compared to the SDWA requirements indicated that there were no changes in compliance as compared to the NAA.

## Clean Water Act

The Clean Water Act (CWA) gave the EPA the authority to develop a program to make all waters of the United States “fishable and swimmable.” This program has included identifying existing and proposed beneficial uses and methods to protect and/or restore those beneficial uses. The CWA contains many provisions, including provisions that regulate the discharge of pollutants into the water bodies. The discharges may be direct flows from point sources, such as an effluent from a wastewater treatment plant, or a non-point source, such as eroded soil particles from a construction site. The analysis of the EA alternatives as compared to the CWA requirements indicated that there were no changes in compliance as compared to the NAA.

SECTION 5
# REFERENCES


Advisory Council on Historic Preservation (ACHP). 1985. Guidelines for Consideration on Traditional Cultural Values in Historic Preservation Review. Draft Report.

Barnhart, R.A. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest) –steelhead. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.60). U.S. Army Corps of Engineers, TR EL-82-4. 21pp.

California Agricultural Statistics Service (CASS). 1995. County Agricultural Commissioner Reports. 1995.

__________. 1999a. http://www.calmis.cahwnet.gov/file/lfhist/cal$hlf.txt. Updated February 28, 2000.

California Department of Fish and Game (CDFG). 1998. California Demographics. Spring.

__________. 1987. Delta Outflow Effects on the Abundance and Distribution of San Francisco Bay Fish and Invertebrates, 1980-1985; (DFG Exhibit No. 60, State Water Resources Control Board 1987 water quality/water rights proceeding for the San Francisco Bay/Sacramento-San Joaquin Delta, Sacramento, CA.) Sacramento, CA.

__________. 1987b. The Status of San Joaquin Drainage Chinook Salmon Stocks, Habitat Conditions and Natural Production Factors: (DFG Exhibit No. 15, State Water Resources Control Board 1987 water quality/water rights proceeding for the San Francisco Bay/Sacramento-San Joaquin Delta, Sacramento, CA.) Sacramento, CA.

__________. 1991. Striped Bass Management Program for Fiscal Year 1991-92 for the Sacramento-San Joaquin Estuary: Phase II: Sacramento, CA.

__________. 1999. California Employment Development Department (EDD). 1999. http://www.calmis.cahwnet.gov/file/lfhist/98aasub.txt. March 3.

California natural diversity data base. Sacramento, CA. 1991. California natural diversity data base. Sacramento, CA. 1991.

__________. 1999.

California Department of Water Resources (DWR). 1998. California Water Plan Update. Bulletin 160-98. January 1998.

CH2M Hill. 1999. Technical Memorandum Economic Analysis of Analysis of November 1999 Tiered Pricing Proposal for PEIS Preferred Alternative. April 24. Updated September 8.

Dealy, Carl. 1999. Natural Resource Specialist. US Bureau of Reclamation, 2666 N. Grove Industrial Dr., Suite 106, Fresno, CA 93727. (559) 487-5139. Andy Gordus, H.T. Harvey meeting on September 18, 1999 to discuss general land use and biological issues in Friant Division.

Edwards, E.A.; Krieger, D.; Bacteller, M.; and Maughan, O.E. 1982a. Habitat Suitability Index Models: Black Crappie: (FWS/OBS-82/10.6.) Washington, DC, U.S. Fish and Wildlife Service, Office of Biological Services, Western Energy and Land Use Team.

Edwards, E.A.; Krieger, D.; Gebhard, G.; and Maughan, O.E. 1982b. Habitat Suitability Index Models: White Crappie: (FWS/OBS-82/10.7.) Washington, DC, U.S. Fish and Wildlife Service, Office of Biological Services, Western Energy and Land Use Team.

Elsasser, Albert B. 1978. Development of Regional Prehistoric Cultures. In Heizer, R. F., ed., Smithsonian Handbook of North American Indians Volume 8: California. Smithsonian Institution, Washington.

Emig, J.W. 1966. Smallmouth Bass, in A. Calhoun, ed., Inland Fisheries Management. Sacramento, CA, California Department of Fish and Game, pp. 354-365.

Flosi, G., S. Downie, J. Hopelain, M. Bird, R. Coey, and B. Collins. 1998. California salmonid stream restoration manual.

Friant Water Users Authority (FWUA). 1998. Information Report, Friant-Kern Canal and Supporting Facilities. April 3, 1998.

Goodson, L.F. 1965. Diets of Four Warmwater Game Fishes in a Fluctuating, Steep-Sided California Reservoir: California Fish and Game, Vol. 51, No. 4. pp. 259-269.

Hallock, R.J.; Elwell, R.F.; and Fry, D.H., Jr. 1970 Migrations of Adult King Salmon, *Oncorhynchus tshawytscha*, in the San Joaquin River Delta as Demonstrated by the Use of Sonic Tags: (Fish Bulletin 151.) Sacramento, CA, California Department of Fish and Game.

Healy, M.C. 1991. Life History of Chinook Salmon, in C. Groot and L. Margolis, eds., Pacific Salmon Life Histories: Vancouver, British Columbia, UBC Press, pp. 313-393.

H.T. Harvey & Associates. 1995. Background report Madera County general plan update biological resources (general plan update advisory committee review draft). October (HTH 782-01) Fresno, California. Prepared for J. Laurence Mintier and Associates, Sacramento, California.

Hickman, J. C. (ed.). 1993. Jepson manual: higher plants of California. University of California Press, Berkeley, California.

Holland, R. F. 1986. Preliminary descriptions of the terrestrial natural communities of California. Nongame Heritage Program, California Department of Fish and Game, Sacramento, California. 156 pp.

Holland, V. L., and D. J. Keil. 1989. California vegetation. Poor Richards Press, San Luis Obispo, California. 375 pp.

___________. 1995. California vegetation. Kendall/Hunt Publishing Company, Dubuque, Iowa. 516 pp.

Jones & Stokes Associates, Inc. 1998. Historical riparian habitat conditions of the San Joaquin River-Friant Dam to the Merced River. April. (JSA 97-302) Sacramento, CA. Prepared for US Bureau of Reclamation, Fresno, CA.

Leidy, G., and Myers, M. 1984. Central Valley Fish and Wildlife Management Study: Fishery Management Problems at Major Central Valley Reservoirs, California; Special Report: Sacramento, CA, U.S. Bureau of Reclamation, Mid-Pacific Region.

Mayer, K. E., and W. F. Laudenslayer. 1988. A guide to wildlife habitats of California. California Department of Forestry and Fire Protection, Sacramento, California. 166 pp.

Moratto, Michael J. 1984. California Archaeology. Academic Press, San Francisco.

Moyle, P.B. 1976. Inland Fishes of California: Berkeley, University of California Press.

Pauley G.B.; Bortz, B.M.; and Shepard, M.F. 1986. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Pacific Northwest)—Steelhead Trout: (Biological Report 82[11.62], TR EL-82-4.) Prepared for U.S. Fish and Wildlife Service, Washington, DC, and U.S. Army Corps of Engineers, Vicksburg, MS.

Reynolds, F.; Mills, T.J.; Benthin, R.; and Low, A. 1993. Central Valley Anadromous Fisheries and Associated Riparian and Wetland Areas Protection and Restoration Action Plan: Sacramento, California Department of Fish and Game, Inland Fisheries Division.

Rhodehamel, Westley M. 1991. A management oriented study of habitat selection and effects of boating activities on wintering Bald Eagles, Millerton Lake State Recreational Area, California. California State University, Fresno. 75 pp.

San Joaquin River Management Program Advisory Council. 1992. San Joaquin River Management Program; Second Annual Report to the Legislature: Sacramento, CA.

San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD). 1994. SJVUAPCD 1994 Serious Area PM10 Plan. September 14.

Schaffter, R.G. 1980. Fish Occurrence, Size, and Distribution in the Sacramento River near Hood, California, during 1973 and 1974: (Administrative Report No. 80-3.) Sacramento, CA, California Department of Fish and Game.

Scroggs, David. 1999. Land and Water Use Section Chief. California Department of Water Resources, 3374 E. Shields Ave., Room A7, Fresno, CA 93726. (559) 230-3315. September 18, 1999 meeting with Mr. Andrew Gordes, H.T. Harvey and Associates, to collect land use data within the Friant Division service contract area.

Skinner and Pavlik. 1994. Vascular Plants Listed by the California Native Plant Society.

Suydam, Robert S. and E. Tyler Conrad. 1985. Wintering Bald Eagles at Millerton Lake, Fresno/Madera Counties. California Department of Parks and Recreation, Millerton Lake State Recreation Area, CA. 42 pp.

U.S. Army Corp of Engineers. 2000a. Annual Water Quality Report, Eastman Lake, Water Year 1999, Sacramento District. Sacramento, CA.

__________. 2000b. Annual Water Quality Report, Hensley Lake, Water Year 1999, Sacramento District. Sacramento, CA.

URS. 2000. Water Banking Proposal Overview for Pilot Project 2000 Maintenance Flows, Oakland, CA.

U.S. Bureau of Reclamation (Reclamation). 1986. Mid-Pacific Region, Sacramento District. Central Valley Fish and Wildlife Management Study - Fishing Access at Major Water Project Facilities in the Cental Valley, CA. Prepared for U.S. Department of the Interior, Washington, D.C.

__________. 1986b. Evaluation of the Potential of a Comprehensive Restoration Program for the San Joaquin River Salmon Fishery, Special Report: Sacramento, CA.

__________. 1994a. Draft Environmental Assessment for the Interim Renewal of 67 Repayment or Water Service Contracts. September 16.

__________. 1994b. Final Environmental Assessment for the Interim Renewal of 67 Repayment or Water Service Contracts. December 20.

__________. 1997a. Supplemental Environmental Assessment for the Renewal of 54 Interim Water Service Contracts through February 29, 2000 Central Valley Project, California. September.

__________. 1997b. Environmental Assessment for the Execution of 14 Interim Water Service Contracts through February 28, 2001. December.

__________. 1999. Central Valley Project Improvement Act Programmatic Environmental Impact Statement, Preliminary Administrative Draft of the Final. September.

__________. 1999a. Final Programmatic Environmental Impact Statement, Central Valley Project Improvement Act. October 1999.

__________. 1999b. CVP Long-Term Contract Renewals, Financial Workshop. November 17, 1999.

__________. 1999c. Friant Division Project Data. 1999.

__________. 1999d. Cross Valley Division Project Data. 1999.

_________. 2000. Final Water Needs Assessments for Individual Irrigation Districts within the Friant Division and Cross Valley Canal. July 28, 2000.

__________. 2000a. Draft Water Needs Assessments for Individual Irrigation Districts within Friant and Cross Valley Divisions. 2000.

U.S. Department of Agriculture (USDA). 1971. Soil Survey Of Tulare County, California, Cental Part. Soil Conservation Service and U.S. Department of Interior, Bureau of Indian Affairs in cooperation with U.C. Agricultural Experiment Station. February.

__________. 1982. Soil Survey Eastern Fresno Area, California. Soil Conservation Service in Cooperation with California Agricultural Experiment Station. October.

__________. 1997. USDA County Profiles.

__________. 1999. County Agricultural Commissioners Report. August 1999.

U.S. Fish and Wildlife Service. 1991. Biological opinion for the Friant Division water contract renewals. USFWS, Sacramento, California. October 15.

__________. 1995. Reinitiation of Formal Endangered Species Consultation and Conference on the Interim Renewal of 67 Water Service Contracts of the Central Valley Project, California. February 27.

U.S. Forest Service (USFS). 1973. Visual Resource Management Guides, Visual Quality Standard Determination and Application, California Region. Washington, D.C., Government Printing Office (GPO).

__________. 1976. National Forest Landscape Management, Volume 2, Chapter 1, The Visual Management System, California Region Lands cape Character Types and Variety Class Criteria. Washington, D.C., GPO.

Vogel and Marine. 1991.

Vogel, D.A., and Marine, K.R. 1991. U.S. Bureau of Reclamation Central Valley Project Guide to Upper Sacramento River Chinook Salmon Life History: CH2M Hill, Redding, CA.

Von Geldern, C.E. 1974. Black Bass: What Does the Future Hold in Store for These Five Game Fish in California? Outdoor California, Vol. 35, No. 1, pp. 13-16.

Wallace, William J. 1978. Southern Valley Yokuts. In Robert F. Heizer, ed. Handbook of North American Indians, Volume 8: California, pp.448-470. Smithsonian Institution, Washington D.C.

Zeiner, David C., William F. Laudenslayer, Kenneth E. Mayer and Marshall White. ED. 1988. California's Wildlife. Volume I. Amphibians and Reptiles. Department of Fish and Game. Sacramento, CA. 272 pp.

___________. ED. 1988. California's Wildlife. Volume II. Birds. Department of Fish and Game. Sacramento, CA. 731 pp.

___________. 1988. California's Wildlife. Volume III. Mammals. Department of Fish and Game. Sacramento, CA. 407 pp.

| Common Name | Scientific Name | Federal Status | State Status |
|---|---|---|---|
| **Reptiles** | | | |
| Western Pond Turtle | *Clemmys marmorata* | None | SC |
| California Horned Lizard | *Phrynosoma coronatum frontale* | None | SC |

# APPENDIX B

# 1991 BIOLOGICAL OPINION SUMMARY

# RECLAMATION COMMITMENTS FOR IMPLEMENTATION OF CVP INTERIM RENEWAL CONTRACTS BIOLOGICAL OPINION DATED FEBRUARY 27, 1995

On February 27, 1995, the Fish and Wildlife Service issued its final Biological Opinion addressing Reclamation's action of the interim renewal of 67 water contracts of the Central Valley Project. This interim renewal of long term contracts was provided for in the Central Valley Project Improvement (CVPIA). The CVPIA disallowed the renewal of any long term contracts prior to the completion of a Programmatic Environmental Impact Statement Act, and any other necessary environmental compliance activities. The interim contracts were provided as a bridge to allow water deliveries to continue during the period between the expiration of existing contracts and completion of the PEIS and other needed environmental compliance activities.

The Interim Contract Biological Opinion was a non-Jeopardy Opinion and included a number of commitments made by Reclamation to address concerns relative to listed species, along with other various requirements of the Opinion itself. One of the requirements of the Opinion was that Reclamation provide an annual report addressing implementation of the various requirements contained in the Opinion, with the first report due by March 31, 1996. Reports have been submitted by Reclamation yearly.

Commitments Made by the Bureau of Reclamation

1.(a) Notify Districts Regarding Endangered Species Act Requirements
1.(b) Develop information on distribution and habitat of listed, proposed and candidate species.
1.(c) Map and distribute information developed in 1.(b) above.
1.(d) Monitor land use changes and ongoing activities to ensure project water is not used in a manner that adversely affects listed, proposed or candidate species. Coordinate with the Service on any identified such activities.

2 (a) Work with the Service, California Department of Pesticide Regulationand others to develop guidelines and information assessing the effects of pesticides on listed proposed and candidate species.
2.b) Develop and distribute guidance on construction and maintenace activities
2.c) Review water conservation plans prior to implementation
2(d). Amend criteria for water conservation plans

3.a) Identify lands critical to listed and proposed species
3.b) Identify land and water use activities critically impacting listed and proposed species
3.c) Develop and implement critical need plan

4. Develop a long-term program to address overall effects of the CVP and Implementation of the CVPIA.

SERVICE REPORTING REQUIREMENTS

1. Meet with the FWS at least quarterly.
2. Provide annual reports to the FWS providing information on various activities as presented in the following sections:
   - (a) Implementation progress of Biological Opinions that have addressed service area effects of the CVP
   - (b) Deliveries provided via Interim Contract relative to historic amounts.
   - (c) Description of all Reclamation actions undertaken by Reclamation that had no effect.
3. Require districts to report take of listed species.
4. Meet with the FWS if incidental take is exceeded.

# 1991 FRIANT BIOLOGICAL OPINION FOR RENEWAL OF LONG TERM WATER SERVICE CONTRACTS

BACKGROUND OF 1991 ACTION: The Friant Division requested a formal consultation with the Fish and Wildlife Service (Service) pursuant to section 7 of the Endangered Species Act of 1973, as amended, as part of renewal of 28 long-term water service contracts. Reclamation committed to initiating consultation on other aspects of the CVP so that the interrelated and interdependent impacts, and cumulative effects on species outside the San Joaquin Valley could be fully addressed. With that in mind, the Service issued its Biological Opinion on October 15, 1991, and Amendment of the Biological Opinion on May 14, 1992. In their Opinion, the Service stated that the renewal of the 28 long-term water service contracts would not likely jeopardize the continued existence of fifteen threatened and endangered species found within the Friant Division service area, provided Reclamation institute short- and long-term endangered species conservation programs to mitigate the adverse impacts of continued water delivery to the Friant Division. This program also committed the Service to participate by providing technical assistance and developing revised recovery plans for the San Joaquin Valley species needed for the timely resolution of listed species concerns. To accomplish the goals of providing technical assistance and writing revised recovery plans, Service established an Endangered Species Recovery Program (ESRP) with BOR funding. The core team to cooperatively address implementation of the Friant Biological Opinion consisted of a member from ESRP, BOR and Service. Other individuals were consulted by the team on an as-needed basis, including species experts, other technical experts and agency representatives.

RECLAMATION'S COMMITMENT: The primary focus is the development and implementation of a long-term program that will identify a comprehensive approach to recovery of all listed species with a Federal nexus to Reclamation throughout the San Joaquin Valley. The program is being developed and implemented by Service and Reclamation, and other Federal, state, and local agencies whose activities have or are affecting listed species. State, Federal, and private actions that adversely affect listed species can be mitigated by contributing to the long-term comprehensive program.

Because development of a long-term program would take several years to fully implement, Reclamation implemented an interim program to protect listed species within the Friant service area. This short-term program was intended to be in effect until components of the long-term conservation program could be developed and implemented. The short-term program had the following components:

1. Reclamation immediately issued notices to all Friant contractors regarding the imperative of protecting all remaining habitat of listed species in the Friant Service area.
2. Reclamation, with assistance from ESRP, initiated a comprehensive biological survey of all lands in the Friant service area to ascertain the distribution of all remaining habitat of listed species, and upon full implementation will notify all contractors of the location of wild lands suitable for listed wildlife species.

3. Reclamation, in coordination with Service and ESRP, provided funds to develop and implement a critical needs plan to identify and secure those habitats requiring immediate protection throughout the Friant service area and also the remainder of the San Joaquin Valley that are vulnerable to agricultural conversion. This information was incorporated into the *Recovery Plan for Upland Species of the San Joaquin Valley, California* which was developed by Service with significant contributions by ESRP and BOR. The Recovery Plan was finalized by the Service on September 9, 1998.
4. Reclamation implemented a plan to prevent take associated with operations and maintenance of Friant Division facilities, and pest control activities by farmers receiving Federal water.
5. Reclamation has consulted with the Service on (a) any requested inclusions or exclusions from the Friant service area, (b) any water contracts involving Friant facilities other than the 28 long-term contracts subject to review in this biological opinion, and (c) any deliveries of water using Friant facilities beyond that addressed in this biological opinion.
6. Reclamation is implementing a long-term plan to prevent/minimize take and contribute to the survival of listed species throughout the San Joaquin Valley.

<u>FULFILMENT OF THE COMMITMENTS UNDER THE FRIANT BIOLOGICAL OPINION:</u>
On November 15, 1991 a letter was sent to contractors regarding the imperative of protecting all remaining habitat of listed species in the Friant Service area.

To base information upon up-to-date land use, Reclamation contracted to fly the San Joaquin Valley for the purpose of taking photographs at a scale of 1:24,000. These photographs became available October 12, 1992. Photographs were analyzed to determine existing potential habitat for endangered species. Reclamation concentrated efforts in the Friant Division and in lands historically occupied by critically endangered species.

In 1993 letters requesting access to private properties for the purpose of conducting wildlife surveys on potential habitat were sent to land owners both within the Friant Service area and outside the service area. This effort created considerable controversy and became a news item on network television and national magazines. Public workshops were held to discuss the surveys. Despite the level of controversy, access was granted for approximately thirty-five thousand acres of land (the Friant Division Service Area is about one million acres). Access was provided by the landowner signing and returning a form to Reclamation giving permission to enter onto their property to survey for plants and/or animals. If the form was not signed and returned, no surveys were conducted. Of the thirty-five thousand acres, only about 75% (26,355 acres) of this land was actually habitat. Drive by surveys were conducted in mid-December, 1993 and subsequently arrangements were made with the owners to survey individual parcels.

Most of the properties surveyed held no listed species, and were found to be too densely vegetated to allow colonization by any listed species, either plants or animals. Three parcels held populations of

Tipton kangaroo rat, *Dipodomys nitratoides*, while several others held populations of the more common kangaroo rat, *D. heermani*. Blunt-nosed leopard lizards *(Gambelia sila*) were found on only one parcel. Vernal pool fairy shrimp *Branchinecta lynchi* were found in pools on one parcel. Plants found include adobe golden sunburst, *Pseudobahia peirsonii* ; Bakersfield cactus, *Opuntia basilaris*; and palmate-bracted bird's beak, *Cordylanthus palmatus* . The Bakersfield cactus was on a property area that although in private ownership, the owners intend to protect the plants.

Subsequent Reclamation efforts have covered Reclamation lands in the Friant Division and in other water service areas. There have also been significant cost-shared efforts with other entities to survey other publicly owned lands. Additional information on surveys are provided under *Notable Accomplishments* below.

A draft critical needs plan to identify and secure those habitats requiring immediate protection throughout the Friant service area and also the remainder of the San Joaquin Valley was developed cooperatively by Service and ESRP. That information was incorporated into the *Recovery Plan for Upland Species of the San Joaquin Valley, California* in September 9, 1998 following several years of gathering existing and new data by ESRP.

Reclamation implemented an interim plan to prevent take associated with operations and maintenance of Friant Division, and, in cooperation with the water authorities, is continuing to revise the operations and maintenance documents that constitute the O&M Plan. The documents consist of an *Operations and Maintenance Plan: Field Manual*, and an *Operations and Maintenance Plan: Endangered, Threatened and Sensitive Species*, intended for use in the field by Reclamation or contract staff as a guide to be used as a reference when conducting or planning operations and maintenance activities. The *Operations and Maintenance Plan: Overview*, is intended to be used by managers and planners. Friant Water User's Authority is developing an Integrated Pest Management Plan that will be used with the O&M Plan. A booklet of sensitive, threatened and endangered information, including photographs has been created to be used in training for staff and as a reference. Reclamation is also working with the Department of Pesticide Regulation to minimize T&E impacts from pesticide application.

Reclamation has consulted with the Service on (a) any requested inclusions or exclusions from the Friant service area, (b) any water contracts involving Friant facilities other than the 28 long-term contracts subject to review in this biological opinion, and (c) any deliveries of water using Friant facilities beyond that addressed in this biological opinion. To avoid the need to repeatedly consult on each action Reclamation and Service are working to develop guidelines and/or seek approval for the same action over a multi-year time period.

Reclamation is implementing a long-term plan to prevent/minimize take and contribute to the survival of listed species throughout the San Joaquin Valley. Reclamation and the Service are providing an ecosystem-based approach to the recovery of listed species in the San Joaquin Valley. The program is one which allows other agencies to contribute efforts or funds to mitigate adverse effects of projects or programs on listed species in the San Joaquin Valley. Reclamation is implementing, as a component of a broader program, items identified in the recovery plan that are Reclamation's responsibility.

Geographic Information Systems (GIS) maps showing such features as: land use, potential habitat, and present species locations is being created by Reclamation. Some information is incomplete and it is anticipated that it may take several more years to complete the GIS maps. This information is being shared with responsible entities who have joined Reclamation and the Service's cooperative effort toward preserving endangered species in the San Joaquin Valley.

These and other aspects of the program should allow more wise future land management decisions to be made for mitigation purposes.

With full implementation of actions committed to by Reclamation under the 1991 Friant Biological Opinion, continued deliveries of water for the Friant Division will continue to fulfill project purposes, while avoiding adverse impact to threatened and endangered species.

**STATUS:**

BOR completed many of the commitments and has significantly contributed to the protection and recovery of a number of T&E species (see attached Friant Biological Opinion Implementation Schedule for tasks, completion dates and status information). Cost sharing and cooperation with other agencies has been significant. In a letter to Reclamation dated February 27, 1998 Service stated that the ongoing efforts by BOR continues to be satisfactory.

It should be noted that the terms and conditions to avoid jeopardy were somewhat different for the Friant Biological Opinion than for the Biological Opinion for Interim Renewal of Water Service Contracts (1995) (Interim BO). Delta and Cross Valley Canal water users had most of the San Joaquin Valley species that were referred to in the Friant Biological Opinion. Reclamation therefore committed to not only implementing the Interim Biological Opinion for the interim water districts, but also included some of the short and long-term measures that were in the Friant Biological Opinion, where applicable. This provided for consistency and addressed issues that were not limited to the Friant Division. A specific example is the evaluation of Reclamation lands to develop a wildlife corridor. Animals such as the San Joaquin kit fox need to travel from one area of habitat to another to assure that populations will not become isolated and subject to genetic problems. This issue is specifically mentioned in the Friant Biological Opinion Reclamation is evaluating its rights-of-way not only in Friant Division but also in the San Luis and Delta areas within the San Joaquin Valley to determine if the lands can be used as a wildlife corridor without causing problems with operations and maintenance of the facilities and if there is a value or need in a particular area to use the right-of-way as a corridor. Prior to implementation of any measures we coordinate with Service, California Department of Fish and Game, and the water authorities to be sure all are in agreement and that no unforseen problems will occur.

## NOTABLE ACCOMPLISHMENTS:

### Recovery Plan for Upland Species of the San Joaquin Valley, California

- The Recovery Plan was written by ESRP with funding from BOR . The draft document was provided to FWS and with editing became their document for official release. Many of the species with which BOR has to deal had little or incomplete information available about them. ESRP, through surveys and specific research and monitoring studies, were able to provide valuable information in the Recovery Plan that will be crucial to ongoing efforts by everyone living or doing business in the San Joaquin Valley. Service has indicated that the multi-species recovery plan is being used as a model by others who are writing recovery plans (Pers. Communication, Cay Goude, USFWS).

### Biological Surveys Leading to Land Protection

- Keck's checkerbloom (*Sidalcea keckii*): A commitment to survey Reclamation owned and withdrawn lands led to the discovery in 1998 of a rare plant, Keck's checkerbloom. Only known from 2 locations in the world and thought to be extinct for 65 years it was rediscovered near Porterville on private land. Reclamation was not involved in the discovery near Porterville but because land withheld to Reclamation was in the vicinity of the second population, it was decided to conduct biological surveys of the land following a multi-year drought. The second population was rediscovered during the year of el nino rainfall. The Sierra Foothill Conservancy, using Central Valley Project Conservation Program funding has secured additional lands and is seeking additional funds to create a preserve of reasonable size to assure protection for the plant. Land was protected by a combination of acquisition and conservation easement.

- Palmate-bracted bird's beak *(Cordylanthus palmatus)* The second largest population of palmate-bracted birds' beak (endangered plant) in the San Joaquin Valley was discovered during biological surveys on private land with the landowner's written permission. The land also includes the endangered blunt-nosed leopard lizard *(Gambelia silas)* and the San Joaquin kit fox (*Vulpes macrotis mutica)* Efforts to protect the site are now being explored by land conservation organizations and the landowner.

### Wildlife Corridors

- San Joaquin Kit Fox (*Vulpes macrotis mutica)*: Reclamation canals may act as a linear barrier in the passage of wildlife, but the rights-of-way can also be used as a pathway through urban and agricultural lands. Reclamation has committed to assess the feasibility of enhancing the passage of wildlife where possible and where it will not interfere with facility operations. ESRP has acquired valuable biological data on the use of rights-of-way and agricultural lands by San Joaquin kit foxes and their interaction with red foxes. Reclamation and the water authorities are installing escape dens to facilitate passage of kit foxes by providing a safe refuge from predators. We are partnering with Caltrans, DWR, DFG, and FWS. Projects are being evaluated on the Friant-Kern Canal, on Reclamation's right-of-way in the city of Bakersfield, and in the Santa Nella area.

# 1991 FRIANT BIOLOGICAL OPINION FOR RENEWAL OF LONG TERM WATER SERVICE CONTRACTS

## Address Potential Effects to T&E Species From O&M Activities and Pesticide Use

- Avoidance measures were developed and are being implemented on Reclamation lands to avoid harm to T&E species. The education of applicators and advisors about the dangers of pesticide use on T&E species was not being adequately provided. Reclamation partnered with Department of Pesticide Regulations (DPR) to provide education to applicators and advisors, including the creation of an educational packet on threatened and endangered species. Education and/or training has to be acquired prior to re-certification of applicators and advisors. That training now includes information specifically on the avoidance of threatened and endangered species.

## Partnering/Cost Sharing to Lower Costs and Maximize Effort

- <u>Madera Equalizing Reservoir</u>: Partnering with Caltrans on a vernal pool project resulted in learning new methods to enhance vernal pools with an added benefit that we were able to fence and protect the Madera Equalizing Reservoir to better manage the riparian vegetation and wildlife. It is a documented foraging area for bald eagles and has a population of two species of endangered orcutt grass . Caltrans provided funding for the project, including a land survey of the property. The fencing project was paid for from still another funding source, and Fresno State partnered to provide a survey of riparian vegetation at no cost to Reclamation. A small Reclamation grant to Fresno State to purchase supplies and materials led to still more habitat improvement to the equalizing reservoir. Fish and Game has tracked radio collared bald eagles to the Madera Equalizing reservoir from larger area reservoirs during noisy weekends (no cost to Reclamation). Fresno State is interested in using the area as an outdoor habitat study area. Less than $10,000 of Reclamation SCC O&M funds have been spent on a project whose total costs are several hundred thousand dollars, counting the land survey. The water district has stated that no adverse impacts to O&M operations has occurred. The knowledge gained benefits wildlife management agencies, the wildlife itself, and has saved funding by avoiding duplication of effort by individual agencies.

## Critical Needs Species

- Reclamation anticipated the most critically endangered species in the valley would be the Fresno kangaroo rat, <u>Dipodomys nitratoides nitratoides</u> whose habitat was largely destroyed through agricultural development. Surveys so far have not shown any populations to still be in existence. Surveys are continuing and Reclamation will assist in the recovery of the species if any are found.
- The most critically endangered species other than the Fresno kangaroo rat is the riparian brush rabbit, *Sylvilagus bachmani riparius*.. Its habitat was along the major rivers including the San Joaquin. It was most recently known from only one population at Caswell Memorial State Park. We are partnering with the State Park, the Folsom BOR office, and the CVPCP to address the protection of the brush rabbit at Caswell. We are also conducting additional surveys to try to locate additional populations and are partnering with the Corps of Engineers to survey Corps fee title lands and flood easements along the Stanislaus River and at other locations.
- Biological surveys have led to the discovery of a second population of the riparian brush rabbit, A large multi-agency effort to initiate captive breeding for the brush rabbit is underway. The Service and State of California Fish and Game are leads, since it is both a Federal and State listed species. Reclamation will be an active participant in the process.

## 1991 FRIANT BIOLOGICAL OPINION FOR RENEWAL OF LONG TERM WATER SERVICE CONTRACTS

**COURT FINDINGS AND ACTIONS:**

C May 30, 1995, Judge Lawrence K. Karlton found a procedural violation of ESA by BOR in executing the contracts.

C February 27, 1995, Service issued a biological opinion on the interim Water Contract Renewals (Interim Renewals Opinion - for districts other than Friant)

C On January 16, 1997, the Federal District Court for the Eastern District of California found the 14 contracts to be invalid. The court stayed its order voiding the contracts until a ruling could be made by an appeal.

C January 20, 1998 Service and BOR re-initiated formal consultation to the Supplemental Interim Renewal of Central Valley Project Water Contracts to include the 14 Friant Water Contracts, as amended January 20, 1998.

C February 27, 1998, Service issued an amendment to the 1995 Interim Renewals Opinion to include interim contract renewals for the 14 Friant water districts bringing the total number of districts covered under the Opinion to 68.

C The amendment adopts the reasonable and prudent measures of the Friant Opinion.

# FRIANT BIOLOGICAL OPINION IMPLEMENTATION SCHEDULE

## Friant Service Area

| Task | Assignment | Completion Date | Status |
|---|---|---|---|
| a. Notice to Contractors | [1]MP | 11/15/91 | Completed |
| b. Amend renewed water service contracts to reflect new terms per Article 14.c. after EIS is complete (except Orange Cove I.D.) | [1]MP | [2]After EIS | [2]no longer applies |
| c. Interim Operations & Maintenance plan for Reclamation owned lands in Friant Division to minimize take from operations and maintenance activities | | | |
| 1. Draft Operations & Maint. plan | [1]SCCAO, MP FWS | 1/15/92 | updated 11/97 IPM plans in process |
| 2. Develop best management practices for privately owned lands receiving USBR water designed to avoid take from pesticide practices and erosion control measures | [1]SCCAO, MP FWS | 10/30/97 working with State Dept Pest Reg | final draft 11/97 Authorities working on IPM Plans; 3 drafts done |
| 3. Final Operations & Maintenance Plan | [1]SCCAO,MP FWS | 2/28/93 | 11/97 draft will be incorporated into Water district IPM Plans |

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[1] = lead; MP = Mid-Pacific Regional Office; SCCAO = South-Central California Area Office; FWS - Fish and Wildlife Service

[2] Through subsequent court action contracts were declared invalid.  FWS included Friant 14 in Interim Biological Opinion through an amendment

# FRIANT BIOLOGICAL OPINION IMPLEMENTATION SCHEDULE

**Friant Service Area**

| Task | Assignment | Completion Date | Status |
|---|---|---|---|
| 4. Begin implementation of Interim Operations & Maintenance Plan (full implementation combined with Long-Term Conservation Plan, see item e) | [1]SCCAO, MP | 2/28/93 | Implementation has begun |
| d. Identify lands in Friant Division service area that provide habitat for listed species (pg 42, #2) | | | |
| 1. Identify habitat types to be shown on maps and necessary scale | [1]FWS, SCCAO, MP | 10/15/93 | Habitat types for aerial mapping completed; more detailed mapping begun in 1999 |
| 2. Acquire existing aerial photos with date close to 1/1/91 to determine losses after 1/1/91[3] | [1]SCCAO | 11/15/92 | Completed |
| 3. Acquire new Friant Service Area aerial photography for comparison with 1/1/91[3] (coordinate with aerials for San Joaquin Valley, item b. for long term plan) | [1]SCCAO | 10/30/92 | Completed (New photos taken 10/12/92) |
| 4. Delineate habitat types on maps (draw lines on maps) | [1]FWS, [1]MP [1]SCCAO | 10/30/97 | Developed by FWS and RPP. In Recov.Plan |

[1] lead; MP = Mid-Pacific Regional Office; SCCAO = South-Central California Area Office; FWS - Fish and Wildlife Service

[3] Per agreement between BOR and FWS, date of photos was to be 1/1/91. However, closest date for photos available was 4/12/90

# FRIANT BIOLOGICAL OPINION IMPLEMENTATION SCHEDULE

## Friant Service Area

| Task | Assignment | Completion Date | Status |
|---|---|---|---|
| 5. Provide aerial photographs to FWS for determination of habitat for listed species | [1]SCCAO(task done by ESRP in Fresno) | 6/15/93 | Completed |
| 6. FWS ground truth areas providing habitat for listed species w/ possible walk-over surveys, w/out sampling to positively determine species present | [1]FWS(task done by ESRP) | 9/15/94 | Complete |
| 7. Document habitat losses between 1/1/91 and 10/12/92 based on comparison of aerials[3] | [1]SCCAO, [1]FWS [1]MP(task done by ESRP,SCCAO) | 9/30/95 | Complete |
| 8. Input information into GIS system to assist with implementation of longterm wildlife conservation plan. | [1]MP | ongoing | Refining data to develop wildlife corridors/monitor Enhancement projects |
| 9. Begin creating GIS maps showing endangered species habitat areas | [1]FWS, [1]MP | ongoing | Madera. Canal, FKC,. DMC ROW's digitized |
| 10. Develop program to replace habitat lost between 1/1/91 and 10/12/92[3] | [1]SCCAO, FWS | 10/30/97 | Draft Mitigation Plan completed |

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[1]= lead; MP = Mid-Pacific Regional Office; SCCAO = South-Central California Area Office; FWS - Fish and Wildlife Service

[3] Per agreement between BOR and FWS, date of photos was to be 1/1/91. However, closest date for photos available was 4/12/90

| | Task | Assignment | Completion Date | Status |
|---|---|---|---|---|
| | 11. Implement program to replace habitat lost between 1/1/91 and 10/12/92[3] | [1]SCCAO, MP SCCAO/FWS | 2001 ongoing | discussions with FWS in process |

**Friant Service Area**

| | Task | Assignment | Completion Date | Status |
|---|---|---|---|---|
| | 12. Develop compensation and mitigation plan for future adverse effects on listed species in Friant Service Area | [1]FWS, [1]SCCAO | 10/30/97 | Draft Mitigation Plan completed |
| | 13. Distribute habitat maps and best management practices to contractors (More detailed maps in process 1999) | [1]MP, FWS | 10/30/97 | Maps in T&E & Spec of Concern Manual avail 12/97 Mgmt prac. In O&M Manual avail 11/97 |
| e. | Critical needs plan - Friant Division service area | | | |
| | 1. Identify species having critical needs | [1]FWS, SCCAO | 9/30/94 | Complete |
| | 2. Identify habitat for listed species requiring immediate protective actions | [1]FWS, SCCAO MP | 10/30/94 | Incorporated into Recovery Plan by FWS |
| | 3. Finalize mapping for listed species habitat requiring immediate protection | [1]FWS, SCCAO MP | 10/30/94 | Incorporated into Recovery Plan |
| | 4. Determine need for acquisition of listed species habitat & make recommendations as appropriate | [1]SCCAO | 10/30/94 | Incorporated into Recovery Plan |
| f. | Long-Term Conservation Plan | [1]SCCAO, [1]FWS | Begin FY 95 Due 2001 | Similar to CVP Conservation Plan May combine |

[1] lead; MP = Mid-Pacific Regional Office; SCCAO = South-Central California Area Office; FWS - Fish and Wildlife Service

# FRIANT BIOLOGICAL OPINION IMPLEMENTATION SCHEDULE

## Long Term Plan for San Joaquin Valley outside the Friant Service Area

| Task | Assignment | Completion Date | Status |
|---|---|---|---|
| a. Develop a Cooperative Agreement to include other entities and agencies whose activities affect listed species in the San Joaquin Valley | [1]FWS, [1]SCCAO | 8/15/94 | Many cooperative efforts have been implemented |
| b. Acquire new set of aerial photographs of remainder of San Joaquin Valley (coordinate with aerials acquired for Friant Service Area item d.3.) | [1]MP | 10/12/92 | Completed. |
| c. Develop and implement a critical needs plan (in conjunction with the critical needs plan for Friant Service Area) | | | |
| 1. Identify species having critical needs | [1]FWS, SCCAO | 9/30/94 | Completed |
| 2. Identify habitat requiring immediate protection | [1]FWS, SCCAO MP | 4/30/94 | Thought to be Fresno kangaroo rat. Possibly Extinct; still looking |
| 3. Finalize mapping of listed species habitat requiring immediate protection | [1]FWS, SCCAO MP | 10/30/94 | Recovery Plan finalized FY '98 |
| 4. Determine need for acquisition of listed species habitat and make recommendations as appropriate | [1]FWS, SCCAO | 8/30/95 | Draft of Recovery Plan sent to FWS; out to pub review 12/97.Final FY '98 |
| d. Conduct a Population Viability Analysis for selected species | [1]FWS, SCCAO | 9/30/95 | In Recovery Plan |

[1] lead; MP = Mid-Pacific Regional Office; SCCAO = South-Central California Area Office; FWS - Fish and Wildlife Service

# FRIANT BIOLOGICAL OPINION IMPLEMENTATION SCHEDULE

## Long Term Plan for San Joaquin Valley outside the Friant Service Area

| Task | Assignment | Completion Date | Status |
|---|---|---|---|
| e. Develop a comprehensive Recovery Plan for listed species in the San Joaquin Valley | [1]FWS, SCCAO & others | 6/30/95 | Finalized FY '98 |
| f. Implementation of Reclamation's component of the comprehensive recovery plan | [1]SCCAO et.al. | Implementation underway. | |

Full Implementation of Reclamation commitments is scheduled for FY 2001

[1] lead; MP = Mid-Pacific Regional Office; SCCAO = South-Central California Area Office; FWS - Fish and Wildlife Service

# APPENDIX C

# ECONOMIC ANALYSIS OF NOVEMBER 1999

**Economic Analysis of November 1999 Tiered Pricing Proposal for PEIS Preferred Alternative**

**Date: October 2, 2000**

This submittal presents the results of an Economic Analysis of the application to the PEIS Preferred Alternative of the November 1999 unit rates for CVP water and Tiered Pricing Proposal.

The PEIS Preferred Alternative included assumptions for the tiered pricing of CVP water that were developed during the preparation of the Draft PEIS. Subsequent to completion of the Final PEIS, a different tiered pricing proposal was developed. In addition, the PEIS assumed 1992 CVP water rates. This analysis includes the 1999 water rates. This submittal applies the new water rates and the November 1999 proposal to the Preferred Alternative and compares the results to the impact analysis of the PEIS Preferred Alternative. The level of detail presented in this submittal is consistent with the level of detail presented in the main PEIS document and the technical appendices. Tables are presented in the same format as used in the PEIS.

The economic analysis includes an evaluation of agricultural economics using Central Valley Production Model (CVPM), municipal and industrial water use economics for CVP water using the spreadsheet presented with the PEIS, and regional economics using IMPLAN. This memorandum discusses the new assumptions in the November 1999 proposal. However, this memorandum does not discuss the basic assumptions used in the PEIS models and analytical tools. This memorandum must be used in conjunction with the Draft PEIS and Final PEIS, including the methodology and modeling technical appendices, to explain the overall assumptions for evaluating the Preferred Alternative in the PEIS.

For the Agricultural Land Use and Economics analysis, the methodology used for applying CVP water rates was modified to allow for the new tiered pricing and the use of blended rates to determine a total water rate for all CVP water applied by an irrigation district or agency. These changes result in changes in water use due to the affordability of CVP water supplies, not a change in reliability.

For the Municipal and Industrial Water Use Economics analysis, blended rates had been used in the PEIS analysis. In addition, this analysis assumes that the municipal and industrial users will be able to afford the calculated water costs, as described in the PEIS. Therefore, CVP water deliveries do not change for the municipal and industrial analysis. The Regional Economics analysis reflects only changes to agricultural and municipal and industrial sectors, but not recreation sectors.

## Table of Contents for Technical Memorandum

**Section 2 Regional Economics**



**Section 3 Municipal and Industrial Water Use Economics**

# SECTION 1

# AGRICULTURAL LAND USE AND ECONOMICS

## CONTRACT RENEWAL PROPOSAL WITH BLENDED WATER RATES

In the November 1999 proposal, Reclamation has proposed that water sold to CVP water service contractors be sold according to tiered water rates as required by CVPIA section 3404. Reclamation has also proposed that two categories of water be identified. Category 1 water would be calculated as the average delivery of the previous five years, and would be split into three tiers according to the 80-10-10 quantities defined in the CVPIA. Category 2 water would be any water available in excess of the 5-year rolling average, up to the total contract amount as defined by the Needs Analysis.

Tier 1 water rates include the cost-of-service component and any applicable Restoration charges and surcharges. Both the Restoration Charge and the capital component of the cost-of-service rate are subject to ability-to-pay limits. These limits are in effect for Bella Vista WD and Clear Creek CSD, contractors on the Corning and Tehama-Colusa Canals, and contractors receiving water from New Melones.

Tier 3 water rates include the full-cost rate (as defined in the Reclamation Reform Act) and any applicable Restoration Charges. No ability-to-pay relief is provided in this Tier. The Tier 2 water rate is the average of the applicable Tier 1 and Tier 3 rates. Category 2 water has the same rate as Tier 3.

For this proposal, it is assumed that water conservation guidelines allow contractors to blend the rate of CVP water delivered in any tier or Category, and that they do blend the rates. This is different from the assumption used to assess alternatives in the PEIS, in which contractors were assumed to sell CVP water to growers at tiered rates. Differences between PEIS pricing assumptions and this analysis are:

- This analysis assumes that contractors blend the price of all CVP water received at tiered rates into a single rate. Tiered rates to growers are assumed in the PEIS.
- The project water portion of Sacramento River water rights settlement contracts are not subject to the new pricing policy in this analysis. In the PEIS it was assumed that it was subject to tiered rates.
- Rates are based on the Irrigation Water Rates spreadsheets provided by Reclamation in November 1999. PEIS rates used the 1994 Irrigation Water Rates manual.
- Ability-to-pay relief is incorporated using the current payment capacity studies for Shasta County irrigation contractors, Corning Canal contractors, Tehama Colusa Canal contractors, and New Melones contractors. In the PEIS, payment capacity was based on a 1992 regional study (PEIS, 1999).

- In this analysis, ability to pay relief is provided in Tier 1, with none in Tier 3 - Tier 2 is the average of Tiers 1 and 3, and so provides 50% relief. In the PEIS, the same dollar amount of ability to pay relief is applied in all pricing tiers.

- A $7.00 per acre-foot Restoration Charge is assumed in this analysis. A $6.50 per acre-foot charge was used in the PEIS. The Friant surcharge was $7.00 per acre-foot in both studies.

- There is no lower bound on the usage of CVP water. In the PEIS each subregion was restricted to using at least the Tier 1 quantity of CVP supplies.

## METHODOLOGY

Other than the differences listed above, the modeling approach and underlying data were the same as used for the PEIS. The Central Valley Production Model (CVPM) was used in this analysis, with modifications needed to assess the specific water pricing conditions proposed. Table 1 shows the regions of the CVPM and the corresponding service areas. Groundwater hydrology was not assessed as it was in the PEIS alternatives. Therefore, for purposes of analysis, most regions were assumed to have access to replacement groundwater if needed. Based on groundwater hydrology as described in the PEIS, the following subregions are assumed to be unable to replace any CVP water with groundwater on a long term basis: Shasta County irrigation contractors (subregion 1), Corning Canal contractors (subregion 2), and the Tehama-Colusa service area (subregion 3B).

Water deliveries from the CVPIA Preferred Alternative were used (Reclamation CVPIA PEIS, 1999). These deliveries were allocated on a yearly basis into pricing tiers and categories according to the rules described above. Weighted average (i.e., blended) prices were calculated for each year, with quantities in each tier and category based on the previous five years of delivery. In any given year, the quantity and blended price of water depends on the 6-year sequence leading up to and including the current year. Throughout this report the following conventions are use: an Average rear represents the average 1922-1990 water delivery from the CVPIA Preferred Alternative (Reclamation CVPIA PEIS, 1999); a Wet year represents the average delivery for the period of 1967-1971 from the CVPIA Preferred Alternative; and a Dry year is the average 1928-1934 delivery from The CVPIA Preferred Alternative.

# AGRICULTURAL LAND USE AND ECONOMICS

A total of nine water supply sequences are assessed in this analysis and compared to the CVPIA Preferred Alternative:

| | |
|---|---|
| Average-Average: | An average water year following a 5-year sequence of average years. |
| Wet-Average: | An average water year following a 5-year sequence of wet years. |
| Dry-Average: | An average water year following a 5-year sequence of dry years. |
| Average-Wet: | A wet water year following a 5-year sequence of average years. |
| Wet-Wet: | A wet water year following a 5-year sequence of wet years. |
| Dry-Wet: | A wet water year following a 5-year sequence of dry years. |
| Average-Dry: | A dry water year following a 5-year sequence of average years. |
| Wet-Dry: | A dry water year following a 5-year sequence of wet years. |
| Dry-Dry: | A dry water year following a 5-year sequence of dry years. |

The CVP water rates used for each of the nine sequences described above and the CVPIA Preferred Alternative tiered prices are shown in Table 3. Tables 4-12 show the available CVP water service contract supplies by tier and the blended price for each of the 22 subregions under the nine sequences proposed for the Long-Term Contract Renewal analysis.

Results are shown for each of the nine sequences presented as differences compared to the CVPIA Preferred Alternative.  When calculating differences from the CVPIA Preferred Alternative, sequences ending in an Average, Wet and Dry years are compared to the Average, Wet and Dry year CVPIA Preferred Alternative results respectively.

## IRRIGATED ACRES

Changes in irrigated acres from the Preferred Alternative are summarized by region in Table 13. A complete list of changes by crop and subregion is provided as Table 17.

Both the Average-Average and Wet-Average scenarios show little difference from the Preferred Alternative under the Average hydrology conditions. The Dry-Average sequence shows a larger reduction in irrigated acres almost all of which comes from the Sacramento River region. Compared to the Wet year Preferred Alternative results, there is a similar pattern for the three Long-Term Contract Renewal sequences ending with Wet years. For all three of the Long Term Contract Renewal Sequences ending in a dry year there minimal increases in irrigated acreage compared to the Dry year CPVIA Preferred Alternative results. Irrigated acres remain unchanged under all nine sequences in the San Felipe Division.

The reduction in acreage in Average and Wet years preceded by a series of Dry years is a result of higher CVP water costs. Since the quantity of Category 1 water is based on the average deliveries of the preceding five years, the quantity of water eligible for Category 1 classification shrinks when a sustained drought is experienced. In an average or wet year follows a drought period, water becomes available however a large portion is classified as Category 2 and is priced at the full cost rate. This can be seen in Tables 6 and 9. When this relatively large block of full cost water is incorporated into the blended water price, all CVP supplies become more expensive, and sometimes unaffordable. This result is not seen in the dry-dry sequence because there is not excess water that gets classified as Category 2.

## GROSS AND NET REVENUE

Gross revenue (value of production) impacts follow acreage impacts quite closely, and are shown by region in Table 14. Compared to the Average Preferred Alternative, a small reduction of less than $1 million is estimated for the Average-Average and Wet-Average scenarios, and a $39 million reduction is estimated in Dry-Average scenario. Gross revenue also declines compared to the Wet Preferred Alternative with approximately $5 million reductions in Average and Wet years and a larger reduction of $29 million in the Dry-Wet scenario. In dry years preceded by all three hydrologic conditions, gross revenue is slightly higher when compared to the Preferred Alternative Dry year results. There were no changes in gross revenue for the San Felipe Division since there were no changes in irrigated acres compared to the CVPIA preferred Alternative.  A complete list of changes in gross revenue by crop and subregion is provided as Table 18.

Net revenue impacts are separated into five components; Fallowed land, Groundwater pumping costs, Irrigation Costs, CVP water costs and higher crop prices. The CVP water cost component represents the impact to net revenue from changes in both the quantity of CVP water used and the price of CVP water. Therefore when the blended CVP water price increases, farmers frequently use less, and the net impact to the CVP water cost component can be positive even when the water price is higher. Table 15 summarizes the net income impacts by component. A negative entry in the table indicates a reduction in net revenue. A complete list of changes in net income by component for each subregion is provided as Table 19.

Relatively small net income impacts are seen in all water supply sequences at the State level. The Average-Average sequence compared to the Average year Preferred Alternative shows a decline of $2 million in net revenue for all of California. The Wet-Average scenario is estimated to have a net increase of approximately $4 million and the Dry-Average sequence a decrease of $12 million.

The net revenue impact in wet years relative to the Preferred Alternative wet results show a pattern similar to the Average year results. Dry years preceded by a series of Average and Wet years both show net decrease in revenue of about $12 million while the Dry-Dry sequence results in a $15 million decrease in State wide net revenue relative the Preferred Alternative Dry results.

Notice that following a series of dry years, the net revenue component associated with crop prices often results in a positive impact to net revenue. This occurs because some subregions are forced to reduce acreage because of higher blended CVP water prices, resulting in higher crop prices received for acreage that remains in production.

There is a negative impact to net revenue from irrigation costs in the Sacramento and San Joaquin River regions in each of the nine Long-Term Contract Renewal sequences. This impact is derived from the irrigation efficiency improvements induced by higher CVP water prices in the Average year sequences. The change in irrigation efficiency is carries through to the Wet and dry year sequences because they are short run analyses and irrigation technology is fixed in the short run. The increase in irrigation efficiency results in a reduction in the total water used in some subregions while irrigated acreage remains constant.

## WATER USE

Table 16 summarizes water use changes by region. A complete list of changes in CVP water use and groundwater use by subregion is provided as Table 20. Water supplies other than CVP project water and groundwater are unaffected and not shown. The San Joaquin River region and most of the sequences for the Sacramento River region show the typical response represented by a shift away from CVP supplies to groundwater as CVP water becomes more expensive under the new pricing schemes. The Tulare Lake region and the Sacramento River region during wet years proceeded by a series of Average and Wet years show what would be considered an atypical response.

In the Sacramento River region when five years of Wet and Average conditions are followed by a wet year, the model predicts that both groundwater and CVP water use will decline relative to the Preferred Alternative Wet condition. The decrease in groundwater use is mostly attributed to subregion 3b. In this subregion in a wet year coming out of a series of Average or Wet years the blended price is cheaper than the Preferred Alternative Tier 2 water cost as well as the cost of pumping groundwater. Therefore there is a shift away from groundwater to CVP supplies. In Average years preceded by Average or Wet years, the subregion is prevented from shifting to CVP because they are already using their full CVP supply.

In the Tulare Lake region there is a pattern of shifting from groundwater to CVP water that can be attributed to subregions 17. This subregion shifts because under the blended pricing scheme the CVP water becomes cheaper than pumping groundwater; therefore they maximize their CVP water use.

In average and wet years preceded by a series of dry years, there is a large decrease in CVP water use in both the Sacramento and San Joaquin River regions. This is driven by the relatively high cost of CVP supplies under these conditions. Since many subregions receive less water in dry years, or the water falls into the higher tiers and it becomes unaffordable, and the base from which the blended price tier quantities is calculated shrinks. This sets up a condition where when an Average or Wet year comes along, the additional water is classified as Category 2 and assessed the full cost price. The CVP blended price is a weighted average of all CVP supplies therefore the cost for all CVP water increases and the supplies often become unaffordable.

## LOCALIZED IMPACTS

Certain subregions are substantially affected by the proposed water pricing.

- The Tehama-Colusa service area is the most-affected region. Limited groundwater availability and very high full-cost price relative to the value of water in agricultural production result in almost 60,000 acres out of production in the Dry-Average sequence and substantially higher cost for lands remaining in production. This analysis shows a one-year snapshot. Because water pricing is based on historic delivery, a region (such as the Tehama-Colusa region) may never be able to “buy its way” back out from a drought. Looked at over a sequence of dry years such as 1928-34 or 1987-92, many or most of the districts in this area could not survive as CVP contractors.

- The analysis predicts that the Delta subregion will make a complete switch to groundwater supplies in all nine hydrologic sequences, assuming groundwater is available in all parts of the service area.

- The analysis estimates that the once an extended drought is experienced the Delta-Mendota service area would switch from its CVP water service supply to groundwater, assuming groundwater is available in all parts of the service area.

- Westlands Water District and many of the Friant Unit contractors would likely continue purchasing CVP water. Since these areas continue to purchase CVP supplies in all years coming out of drought conditions, they would eventually build their base deliveries up or "buy their way" back to pre-drought tier quantities and prices.

**TABLE 1**
**CVPM SUBREGIONS AND DESCRIPTIONS**

| CVPM Subregion | Description of Major Water Users |
|---|---|
| 1 | CVP Users: Anderson Cottonwood, Clear Creek, Bella Vista, Sacramento River miscellaneous users. |
| 2 | CVP Users: Corning Canal, Kirkwood, Tehema, Sacramento River, miscellaneous users. |
| 3 | CVP Users: Glenn Colusa ID, Provident, Princeton-Codora, Maxwell, and Colusa Basin Drain MWC. |
| 3B | Tehama Colusa Canal Service Area. CVP Users: Orland-Artois WD, most of County of Colusa, Davis, Dunnigan, Glide Kanawha, La Grande, Westside WD. |
| 4 | CVP Users: Princeton-Codora-Glenn, Colusa Irrigation Co., Meridian Farm WC, Pelger Mutual WC, Recl. Dist. 1004, Recl. Dist. 108, Robers Ditch, Sartain M.D., Sutter MWC, Swinford Tract IC, Tisdale Irrigation, Sacramento River miscellaneous users. |
| 5 | Most Feather River Region riparian and appropriative users. |
| 6 | Yolo, Solano Counties. CVP Users: Conaway Ranch, Sacramento River miscellaneous users. |
| 7 | Sacramento Co. north of American River. CVP Users: Natomas Central MWC, Sacramento River miscellaneous users, Pheasant Grove-Verona, San Juan Suburban. |
| 8 | Sacramento Co. south of American River, San Joaquin Co. |
| 9 | Delta Regions. CVP Users: Banta Carbona, West Side, Plainview. |
| 10 | Delta Mendota Canal. CVP Users: Pacheco, Del Puerto, Hospital, Sunflower, West Stanislaus, Mustang, Orestimba, Patterson, Foothill, San Luis WD, Broadview, Eagle Field, Mercy Springs, Pool Exchange Contractors, Schedule II water rights, more. |
| 11 | Stanislaus River water rights: Modesto ID, Oakdale ID, South San Joaquin ID. |
| 12 | Turlock ID. |
| 13 | Merced ID. CVP Users: Madera, Chowchilla, Gravely Ford. |
| 14 | CVP Users: Westlands WD. |
| 15 | Tulare Lake Bed. CVP Users: Fresno Slough, James, Tranquility, Traction Ranch, Laguna, Real. Dist. 1606. |
| 16 | Eastern Fresno Co. CVP Users: Friant-Kern Canal. Fresno ID, Garfield, International. |
| 17 | CVP Users: Friant-Kern Canal. Hills Valley, Tri-Valley Orange Cove. |
| 18 | CVP Users: Friant-Kern Canal, County of Fresno, Lower Tule River ID, Pixley ID, portion of Rag Gulch, Ducor, County of Tulare, most of Delano Earlimart, Exeter, Ivanhoe, Lewis Cr., Lindmore, Lindsay-Strathmore, Porterville, Sausalito, Stone Corral, Tea Pot Dome, Terra Bella, Tulare. |
| 19 | Kern Co. SWP Service Area. |
| 20 | CVP Users: Friant-Kern Canal. Shafter-Wasco, S. San Joaquin. |
| 21 | CVP Users: Cross Valley Canal, Friant-Kern Canal. Arvin Edison. |

**TABLE 2**

**CVP WATER RATES USED FOR LONG TERM CONTRACT RENEWAL ANALYSIS ($)**

| CVPM Subregion | Tiered Water Rates Used for LTCR analysis | | | Proposed Blended Water Rates for Water Service Contracts | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Average | Wet | Dry | Average | Wet | Dry | Average | Wet | Dry |
| | Tier 1 | Tier 2 | Tier 3 | Followed by Average | | | Followed by Wet | | | Followed by Dry | | |
| 1 | 12.01 | 37.56 | 63.12 | 19.67 | 14.98 | 14.14 | 23.91 | 19.67 | 18.20 | 25.19 | 21.09 | 19.67 |
| 2 | 10.71 | 36.40 | 62.09 | 18.42 | 10.71 | 49.66 | 29.55 | 18.42 | 52.83 | 10.71 | 10.71 | 18.42 |
| 3 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 3B | 10.25 | 40.73 | 71.21 | 19.39 | 10.25 | 58.15 | 32.35 | 19.39 | 61.42 | 10.25 | 10.25 | 19.39 |
| 4 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 5 | 20.65 | 23.01 | 25.36 | 21.35 | 21.18 | 21.77 | 21.52 | 21.35 | 21.92 | 20.90 | 20.81 | 21.35 |
| 6 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 7 | 11.77 | 12.07 | 12.37 | 11.86 | 11.86 | 11.86 | 11.86 | 11.86 | 11.86 | 11.86 | 11.86 | 11.86 |
| 8 | 10.00 | 27.46 | 44.92 | 15.24 | 10.00 | 30.36 | 25.64 | 15.24 | 35.47 | 10.00 | 10.00 | 15.24 |
| 9 | 24.79 | 55.14 | 85.50 | 33.89 | 24.79 | 64.53 | 55.27 | 33.89 | 73.22 | 24.79 | 24.79 | 33.89 |
| 10 | 31.15 | 40.16 | 49.16 | 33.85 | 31.15 | 42.94 | 38.01 | 33.85 | 44.63 | 31.15 | 31.15 | 33.85 |
| 11 | 0.00 | 0.00 | 0.00 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 12 | 0.00 | 0.00 | 0.00 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 13 | 32.16 | 38.41 | 44.65 | 34.04 | 33.25 | 37.44 | 34.77 | 34.04 | 37.94 | 32.16 | 32.16 | 34.04 |
| 14 | 32.62 | 46.48 | 60.33 | 36.78 | 32.62 | 50.76 | 43.17 | 36.78 | 53.36 | 32.62 | 32.62 | 36.78 |
| 15 | 32.71 | 41.91 | 51.10 | 35.47 | 34.55 | 38.10 | 36.34 | 35.47 | 38.82 | 33.07 | 32.71 | 35.47 |
| 16 | 40.48 | 46.78 | 53.08 | 42.37 | 41.22 | 45.32 | 43.40 | 42.37 | 46.07 | 40.48 | 40.48 | 42.37 |
| 17 | 34.18 | 40.49 | 46.79 | 36.07 | 35.15 | 39.28 | 36.92 | 36.07 | 39.88 | 34.18 | 34.18 | 36.07 |
| 18 | 33.63 | 40.48 | 47.33 | 35.69 | 34.73 | 39.16 | 36.57 | 35.69 | 39.78 | 33.63 | 33.63 | 35.69 |
| 19 | 34.58 | 42.16 | 49.73 | 36.86 | 35.00 | 41.21 | 38.84 | 36.86 | 42.52 | 34.58 | 34.58 | 36.86 |
| 20 | 34.58 | 42.16 | 49.73 | 36.86 | 35.70 | 40.85 | 37.92 | 36.86 | 41.58 | 34.58 | 34.58 | 36.86 |
| 21 | 32.70 | 39.00 | 45.31 | 34.59 | 32.98 | 39.01 | 36.33 | 34.59 | 40.03 | 32.70 | 32.70 | 34.59 |

NOTES:

1. Blended rates used pricing components from the November, 1999 Irrigation Water Rates spreadsheets, Restoration Charge of $7.00
2. PEIS rates used regional estimates of payment capacity and allowed the same ATP relief in all tiers.
3. Blended rates use most recent available payment capacity studies from Reclamation, and allow ATP relief in Tier 1 but not in Tier 3.
4. Only Class 1 rates are shown for Friant Division. Friant surcharge is $7.00 in all rates.

**TABLE 3**

**CVP WATER RATES USED IN PREFERRED ALTERNATIVE ($)**

| CVPM Subregion | Tiered Water Rates Used in the PEIS Preferred Alternative ($) | | |
|---|---|---|---|
| | Tier 1 | Tier 2 | Tier 3 |
| 1 | 5.91 | 14.63 | 23.35 |
| 2 | 11.83 | 24.7 | 37.57 |
| 3 | 2.83 | 5.27 | 7.71 |
| 3B | 17.16 | 36.225 | 55.29 |
| 4 | 5.32 | 7.625 | 9.93 |
| 5 | 4.53 | 6.965 | 9.4 |
| 6 | 4.53 | 6.82 | 9.11 |
| 7 | 6.63 | 8.83 | 11.03 |
| 8 | 4.53 | 7.095 | 9.66 |
| 9 | 28.54 | 35.245 | 41.95 |
| 10 | 33.46 | 40.015 | 46.57 |
| 11 | 0 | 0 | 0 |
| 12 | 0 | 0 | 0 |
| 13 | 33.65 | 39.395 | 45.14 |
| 14 | 39.31 | 54.385 | 69.46 |
| 15 | 28.16 | 34.875 | 41.59 |
| 16 | 38.25 | 44.255 | 50.26 |
| 17 | 35.58 | 41.905 | 48.23 |
| 18 | 35.01 | 41.255 | 47.5 |
| 19 | 36.68 | 42.885 | 49.09 |
| 20 | 36.68 | 42.885 | 49.09 |
| 21 | 35.4 | 42.01 | 48.62 |

NOTES:
1. PEIS rates used pricing components from the 1994 Irrigation Water Rates Manual, Restoration Charge of $6.50
2. PEIS rates used regional estimates of payment capacity and allowed the same ATP relief in all tiers.
3. Only Class 1 rates are shown for Friant Division. Friant surcharge is $7.00 in all rates.

## TABLE 4

## PROJECT WATER APPLIED BY PRICING TIERS
## AVERAGE YEAR FOLLOWING AVERAGE 5-YEAR BASE CONDITION

| CVPM Subregion | Tier 1 | Tier 2 | Tier 3 | Category 2 | Blended Price ($/AF) |
|---|---|---|---|---|---|
| | (1000 AF) | | | | |
| 1 | 9.4 | 1.2 | 1.2 | - | $ 19.67 |
| 2 | 21.9 | 2.7 | 2.7 | - | $ 18.42 |
| 3 | - | - | - | - | NA |
| 3B | 159.7 | 20.0 | 20.0 | - | $ 19.39 |
| 4 | - | - | - | - | NA |
| 5 | 16.0 | 2.0 | 2.0 | - | $ 21.35 |
| 6 | - | - | - | - | NA |
| 7 | 12.0 | 1.5 | 1.5 | - | $ 11.86 |
| 8 | 41.3 | 5.2 | 5.2 | - | $ 15.24 |
| 9 | 22.5 | 2.8 | 2.8 | - | $ 33.89 |
| 10 | 231.4 | 28.9 | 28.9 | - | $ 33.85 |
| 11 | - | - | - | - | |
| 12 | - | - | - | - | |
| 13 | 153.6 | 19.2 | 19.2 | - | $ 34.04 |
| 14 | 539.1 | 67.4 | 67.4 | - | $ 36.78 |
| 15 | 32.3 | 4.0 | 4.0 | - | $ 35.47 |
| 16 | 18.9 | 2.4 | 2.4 | - | $ 42.37 |
| 17 | 34.9 | 4.4 | 4.4 | - | $ 36.07 |
| 18 | 484.2 | 60.5 | 60.5 | - | $ 35.69 |
| 19 | 13.1 | 1.6 | 1.6 | - | $ 36.86 |
| 20 | 194.2 | 24.3 | 24.3 | - | $ 36.86 |
| 21 | 129.7 | 16.2 | 16.2 | - | $ 34.59 |

**Table 5**

**PROJECT WATER APPLIED BY PRICING TIERS**
**AVERAGE YEAR FOLLOWING WET 5-YEAR BASE CONDITION**

| CVPM Subregion | Tier 1 | Tier 2 | Tier 3 | Category 2 | Blended Price ($/AF) |
|---|---|---|---|---|---|
| | (1000 AF) | | | | |
| 1 | 10.4 | 1.3 | 0.0 | - | $ 14.98 |
| 2 | 27.3 | - | - | - | $ 10.71 |
| 3 | - | - | - | - | NA |
| 3B | 199.6 | - | - | - | $ 10.25 |
| 4 | - | - | - | - | NA |
| 5 | 16.6 | 2.1 | 1.2 | - | $ 21.18 |
| 6 | - | - | - | - | NA |
| 7 | 12.0 | 1.5 | 1.5 | - | $ 11.86 |
| 8 | 51.6 | - | - | - | $ 10.00 |
| 9 | 28.2 | - | - | - | $ 24.79 |
| 10 | 289.2 | - | - | - | $ 31.15 |
| 11 | - | - | - | - | NA |
| 12 | - | - | - | - | NA |
| 13 | 165.0 | 20.6 | 6.3 | - | $ 33.25 |
| 14 | 673.8 | - | - | - | $ 32.62 |
| 15 | 34.2 | 4.3 | 1.9 | - | $ 34.55 |
| 16 | 21.0 | 2.6 | 0.1 | - | $ 41.22 |
| 17 | 37.9 | 4.7 | 1.0 | - | $ 35.15 |
| 18 | 523.8 | 65.5 | 15.9 | - | $ 34.73 |
| 19 | 15.5 | 0.9 | - | - | $ 35.00 |
| 20 | 211.7 | 26.5 | 4.6 | - | $ 35.70 |
| 21 | 154.9 | 7.2 | - | - | $ 32.98 |

**Table 6**

**PROJECT WATER APPLIED BY PRICING TIERS**
**AVERAGE YEAR FOLLOWING DRY 5-YEAR BASE CONDITION**

| CVPM Subregion | Tier 1 | Tier 2 | Tier 3 | Category 2 | Blended Price ($/AF) |
|---|---|---|---|---|---|
| | (1000 AF) | | | | |
| 1 | 10.8 | 1.0 | - | - | $ 14.14 |
| 2 | 6.2 | 0.8 | 0.8 | 19.6 | $ 49.66 |
| 3 | - | - | - | - | NA |
| 3B | 40.2 | 5.0 | 5.0 | 149.3 | $ 58.15 |
| 4 | - | - | - | - | NA |
| 5 | 14.3 | 1.8 | 1.8 | 2.1 | $ 21.77 |
| 6 | - | - | - | - | NA |
| 7 | 12.0 | 1.5 | 1.5 | - | $ 11.86 |
| 8 | 20.2 | 2.5 | 2.5 | 26.3 | $ 30.36 |
| 9 | 9.2 | 1.1 | 1.1 | 16.7 | $ 64.53 |
| 10 | 94.0 | 11.8 | 11.8 | 171.7 | $ 42.94 |
| 11 | - | - | - | - | NA |
| 12 | - | - | - | - | NA |
| 13 | 104.4 | 13.0 | 13.0 | 61.6 | $ 37.44 |
| 14 | 219.1 | 27.4 | 27.4 | 400.0 | $ 50.76 |
| 15 | 26.8 | 3.4 | 3.4 | 6.8 | $ 38.10 |
| 16 | 13.7 | 1.7 | 1.7 | 6.5 | $ 45.32 |
| 17 | 24.5 | 3.1 | 3.1 | 13.1 | $ 39.28 |
| 18 | 339.7 | 42.5 | 42.5 | 180.6 | $ 39.16 |
| 19 | 8.7 | 1.1 | 1.1 | 5.6 | $ 41.21 |
| 20 | 133.9 | 16.7 | 16.7 | 75.3 | $ 40.85 |
| 21 | 76.2 | 9.5 | 9.5 | 66.8 | $ 39.01 |

Table 7

**PROJECT WATER APPLIED BY PRICING TIERS**
**WET YEAR FOLLOWING AVERAGE 5-YEAR BASE CONDITION**

| CVPM Subregion | Tier 1 | Tier 2 | Tier 3 | Category 2 | Blended Price ($/AF) |
|---|---|---|---|---|---|
| | (1000 AF) | | | | |
| 1 | 9.4 | 1.2 | 1.2 | 1.3 | $ 23.91 |
| 2 | 21.9 | 2.7 | 2.7 | 9.4 | $ 29.55 |
| 3 | - | - | - | - | NA |
| 3B | 159.7 | 20.0 | 20.0 | 66.6 | $ 32.35 |
| 4 | - | - | - | - | NA |
| 5 | 16.0 | 2.0 | 2.0 | 0.9 | $ 21.52 |
| 6 | - | - | - | - | NA |
| 7 | 12.0 | 1.5 | 1.5 | - | $ 11.86 |
| 8 | 41.3 | 5.2 | 5.2 | 27.8 | $ 25.64 |
| 9 | 22.5 | 2.8 | 2.8 | 19.9 | $ 55.27 |
| 10 | 231.4 | 28.9 | 28.9 | 107.8 | $ 38.01 |
| 11 | - | - | - | - | NA |
| 12 | - | - | - | - | NA |
| 13 | 153.6 | 19.2 | 19.2 | 14.3 | $ 34.77 |
| 14 | 539.1 | 67.4 | 67.4 | 251.2 | $ 43.17 |
| 15 | 32.3 | 4.0 | 4.0 | 2.4 | $ 36.34 |
| 16 | 18.9 | 2.4 | 2.4 | 2.5 | $ 43.40 |
| 17 | 34.9 | 4.4 | 4.4 | 3.8 | $ 36.92 |
| 18 | 484.2 | 60.5 | 60.5 | 49.6 | $ 36.57 |
| 19 | 13.1 | 1.6 | 1.6 | 3.0 | $ 38.84 |
| 20 | 194.2 | 24.3 | 24.3 | 21.9 | $ 37.92 |
| 21 | 129.7 | 16.2 | 16.2 | 31.5 | $ 36.33 |

Table 8

**PROJECT WATER BY PRICING TIERS**
**WET YEAR FOLLOWING WET 5-YEAR BASE CONDITION**

| CVPM Subregion | Tier 1 | Tier 2 | Tier 3 | Category 2 | Blended Price |
|---|---|---|---|---|---|
| | (1000 AF) | | | | ($/AF) |
| 1 | 10.4 | 1.3 | 1.3 | - | $ 19.67 |
| 2 | 29.4 | 3.7 | 3.7 | - | $ 18.42 |
| 3 | - | - | - | - | NA |
| 3B | 212.9 | 26.6 | 26.6 | - | $ 19.39 |
| 4 | - | - | - | - | NA |
| 5 | 16.6 | 2.1 | 2.1 | - | $ 21.35 |
| 6 | - | - | - | - | NA |
| 7 | 12.0 | 1.5 | 1.5 | - | $ 11.86 |
| 8 | 63.5 | 7.9 | 7.9 | - | $ 15.24 |
| 9 | 38.5 | 4.8 | 4.8 | - | $ 33.89 |
| 10 | 317.6 | 39.7 | 39.7 | - | $ 33.85 |
| 11 | - | - | - | - | NA |
| 12 | - | - | - | - | NA |
| 13 | 165.0 | 20.6 | 20.6 | - | $ 34.04 |
| 14 | 740.0 | 92.5 | 92.5 | - | $ 36.78 |
| 15 | 34.2 | 4.3 | 4.3 | - | $ 35.47 |
| 16 | 21.0 | 2.6 | 2.6 | - | $ 42.37 |
| 17 | 37.9 | 4.7 | 4.7 | - | $ 36.07 |
| 18 | 523.8 | 65.5 | 65.5 | - | $ 35.69 |
| 19 | 15.5 | 1.9 | 1.9 | - | $ 36.86 |
| 20 | 211.7 | 26.5 | 26.5 | - | $ 36.86 |
| 21 | 154.9 | 19.4 | 19.4 | - | $ 34.59 |

## Table 9

### PROJECT WATER APPLIED BY PRICING TIERS
### WET YEAR FOLLOWING DRY 5-YEAR BASE CONDITION

| CVPM Subregion | Tier 1 | Tier 2 | Tier 3 | Category 2 | Blended Price |
|---|---|---|---|---|---|
| | (1000 AF) | | | | ($/AF) |
| 1 | 10.8 | 1.3 | 0.9 | - | $ 18.20 |
| 2 | 6.2 | 0.8 | 0.8 | 28.9 | $ 52.83 |
| 3 | - | - | - | - | NA |
| 3B | 40.2 | 5.0 | 5.0 | 215.9 | $ 61.42 |
| 4 | - | - | - | - | NA |
| 5 | 14.3 | 1.8 | 1.8 | 2.9 | $ 21.92 |
| 6 | - | - | - | - | NA |
| 7 | 12.0 | 1.5 | 1.5 | - | $ 11.86 |
| 8 | 20.2 | 2.5 | 2.5 | 54.1 | $ 35.47 |
| 9 | 9.2 | 1.1 | 1.1 | 36.7 | $ 73.22 |
| 10 | 94.0 | 11.8 | 11.8 | 279.5 | $ 44.63 |
| 11 | - | - | - | - | NA |
| 12 | - | - | - | - | NA |
| 13 | 104.4 | 13.0 | 13.0 | 75.9 | $ 37.94 |
| 14 | 219.1 | 27.4 | 27.4 | 651.1 | $ 53.36 |
| 15 | 26.8 | 3.4 | 3.4 | 9.1 | $ 38.82 |
| 16 | 13.7 | 1.7 | 1.7 | 9.1 | $ 46.07 |
| 17 | 24.5 | 3.1 | 3.1 | 16.8 | $ 39.88 |
| 18 | 339.7 | 42.5 | 42.5 | 230.2 | $ 39.78 |
| 19 | 8.7 | 1.1 | 1.1 | 8.5 | $ 42.52 |
| 20 | 133.9 | 16.7 | 16.7 | 97.2 | $ 41.58 |
| 21 | 76.2 | 9.5 | 9.5 | 98.3 | $ 40.03 |

Table 10

**PROJECT WATER APPLIED BY PRICING TIERS**
**DRY YEAR FOLLOWING AVERAGE 5-YEAR BASE CONDITION**

| CVPM Subregion | Tier 1 | Tier 2 | Tier 3 | Category 2 | Blended Price |
|---|---|---|---|---|---|
| | (1000 AF) | | | | ($/AF) |
| 1 | 9.4 | 1.2 | 1.2 | 1.7 | $ 25.19 |
| 2 | 7.8 | - | - | - | $ 10.71 |
| 3 | - | - | - | - | NA |
| 3B | 50.3 | - | - | - | $ 10.25 |
| 4 | - | - | - | - | NA |
| 5 | 16.0 | 1.9 | - | - | $ 20.90 |
| 6 | - | - | - | - | NA |
| 7 | 12.0 | 1.5 | 1.5 | - | $ 11.86 |
| 8 | 25.3 | - | - | - | $ 10.00 |
| 9 | 11.5 | - | - | - | $ 24.79 |
| 10 | 117.5 | - | - | - | $ 31.15 |
| 11 | - | - | - | - | NA |
| 12 | - | - | - | - | NA |
| 13 | 130.4 | - | - | - | $ 32.16 |
| 14 | 273.9 | - | - | - | $ 32.62 |
| 15 | 32.3 | 1.3 | - | - | $ 33.07 |
| 16 | 17.1 | - | - | - | $ 40.48 |
| 17 | 30.6 | - | - | - | $ 34.18 |
| 18 | 424.6 | - | - | - | $ 33.63 |
| 19 | 10.9 | - | - | - | $ 34.58 |
| 20 | 167.4 | - | - | - | $ 34.58 |
| 21 | 95.3 | - | - | - | $ 32.70 |

**Table 11**

**PROJECT WATER APPLIED BY PRICING TIERS**
**DRY YEAR FOLLOWING WET 5-YEAR BASE CONDITION**

| CVPM Subregion | Tier 1 | Tier 2 | Tier 3 | Category 2 | Blended Price ($/AF) |
|---|---|---|---|---|---|
| | (1000 AF) | | | | |
| 1 | 10.4 | 1.3 | 1.3 | 0.4 | $ 21.09 |
| 2 | 7.8 | - | - | - | $ 10.71 |
| 3 | - | - | - | - | NA |
| 3B | 50.3 | - | - | - | $ 10.25 |
| 4 | - | - | - | - | NA |
| 5 | 16.6 | 1.2 | - | - | $ 20.81 |
| 6 | - | - | - | - | NA |
| 7 | 12.0 | 1.5 | 1.5 | - | $ 11.86 |
| 8 | 25.3 | - | - | - | $ 10.00 |
| 9 | 11.5 | - | - | - | $ 24.79 |
| 10 | 117.5 | - | - | - | $ 31.15 |
| 11 | - | - | - | - | NA |
| 12 | - | - | - | - | NA |
| 13 | 130.4 | - | - | - | $ 32.16 |
| 14 | 273.9 | - | - | - | $ 32.62 |
| 15 | 33.6 | - | - | - | $ 32.71 |
| 16 | 17.1 | - | - | - | $ 40.48 |
| 17 | 30.6 | - | - | - | $ 34.18 |
| 18 | 424.6 | - | - | - | $ 33.63 |
| 19 | 10.9 | - | - | - | $ 34.58 |
| 20 | 167.4 | - | - | - | $ 34.58 |
| 21 | 95.3 | - | - | - | $ 32.70 |

Table 12

**PROJECT WATER BY PRICING TIERS**
**DRY YEAR FOLLOWING DRY 5-YEAR BASE CONDITION**

| CVPM Subregion | Tier 1 | Tier 2 | Tier 3 | Category 2 | Blended Price |
|---|---|---|---|---|---|
| | (1000 AF) | | | | ($/AF) |
| 1 | 10.8 | 1.3 | 1.3 | - | $ 19.67 |
| 2 | 6.2 | 0.8 | 0.8 | - | $ 18.42 |
| 3 | - | - | - | - | NA |
| 3B | 40.2 | 5.0 | 5.0 | - | $ 19.39 |
| 4 | - | - | - | - | NA |
| 5 | 14.3 | 1.8 | 1.8 | - | $ 21.35 |
| 6 | - | - | - | - | NA |
| 7 | 12.0 | 1.5 | 1.5 | - | $ 11.86 |
| 8 | 20.2 | 2.5 | 2.5 | - | $ 15.24 |
| 9 | 9.2 | 1.1 | 1.1 | - | $ 33.89 |
| 10 | 94.0 | 11.8 | 11.8 | - | $ 33.85 |
| 11 | - | - | - | - | NA |
| 12 | - | - | - | - | NA |
| 13 | 104.4 | 13.0 | 13.0 | - | $ 34.04 |
| 14 | 219.1 | 27.4 | 27.4 | - | $ 36.78 |
| 15 | 26.8 | 3.4 | 3.4 | - | $ 35.47 |
| 16 | 13.7 | 1.7 | 1.7 | - | $ 42.37 |
| 17 | 24.5 | 3.1 | 3.1 | - | $ 36.07 |
| 18 | 339.7 | 42.5 | 42.5 | - | $ 35.69 |
| 19 | 8.7 | 1.1 | 1.1 | - | $ 36.86 |
| 20 | 133.9 | 16.7 | 16.7 | - | $ 36.86 |
| 21 | 76.2 | 9.5 | 9.5 | - | $ 34.59 |

TABLE 13

IRRIGATED ACRES BY SUBREGION (1000 ACRES)

| CVPM Subregion | Average Preferred Alternative | Change Compared to Average | Change Compared to Wet | Change Compared to Dry | Wet Preferred Alternative | Change Compared to Average | Change Compared to Wet | Change Compared to Dry | Dry Preferred Alternative | Change Compared to Average | Change Compared to Wet | Change Compared to Dry |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | followed by Average | | | | followed by Wet | | | | followed by Dry | | |
| Sacramento River | 2015.5 | -1.7 | -0.8 | -65.3 | 2020.0 | -4.4 | -4.4 | -53.0 | 1984.8 | 0.1 | 0.1 | 0.0 |
| San Joaquin River | 2526.6 | -0.2 | -0.2 | -1.2 | 2529.1 | -1.7 | -1.6 | -1.9 | 2505.9 | -0.1 | -0.1 | -0.1 |
| Tulare Lake | 1992.4 | 0.0 | 0.0 | -0.2 | 1996.2 | -1.2 | -1.2 | -1.3 | 1953.7 | 0.1 | 0.1 | 0.1 |
| San Felipe | 50.7 | 0.0 | 0.0 | 0.0 | 69.5 | 0.0 | 0.0 | 0.0 | 22.2 | 0.0 | 0.0 | 0.0 |
| California Total | 6585.2 | -1.9 | -1.0 | -66.7 | 6614.8 | -7.3 | -7.3 | -56.2 | 6466.6 | 0.1 | 0.1 | 0.1 |

**TABLE 14**

**VALUE OF PRODUCTION BY SUBREGION (Million $)**

| CVPM Subregion | Average Preferred Alternative | Change Compared to Average: Average followed by Average | Change Compared to Average: Wet followed by Average | Change Compared to Average: Dry followed by Average | Wet Preferred Alternative | Change Compared to Wet PA: Average followed by Wet | Change Compared to Wet PA: Wet followed by Wet | Change Compared to Wet PA: Dry followed by Wet | Dry Preferred Alternative | Change Compared to Dry PA: Average followed by Dry | Change Compared to Dry PA: Wet followed by Dry | Change Compared to Dry PA: Dry followed by Dry |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sacramento River | 1,825.3 | -0.4 | -0.2 | -37.6 | 1,828.0 | -1.6 | -1.6 | -26.8 | 1,810.0 | 0.4 | 0.4 | 0.3 |
| San Joaquin River | 4,402.3 | -0.1 | -0.1 | -1.0 | 4,403.8 | -0.9 | -0.9 | -1.1 | 4,384.2 | -0.2 | -0.2 | -0.2 |
| Tulare Lake | 3,876.3 | 0.0 | 0.0 | -0.3 | 3,879.4 | -1.0 | -1.0 | -1.1 | 3,842.7 | 0.1 | 0.1 | 0.1 |
| San Felipe | 68.0 | 0.0 | 0.0 | 0.0 | 70.0 | 0.0 | 0.0 | 0.0 | 44.0 | 0.0 | 0.0 | 0.0 |
| California Total | 10,172.0 | -0.5 | -0.4 | -38.8 | 10,181.2 | -3.6 | -3.6 | -28.9 | 10,080.8 | 0.3 | 0.3 | 0.3 |

**TABLE 15**
**NET REVENUE CHANGES BY REGION (Million $)**

| Cause of Net Revenue Change | Compared to Average Year PA | | | Compared to Wet Year PA | | | Compared to Dry Year PA | | |
|---|---|---|---|---|---|---|---|---|---|
| | Average | Wet | Dry | Average | Wet | Dry | Average | Wet | Dry |
| | followed by Average | | | followed by Wet | | | followed by Dry | | |
| **Sacramento River** | | | | | | | | | |
| Fallowed Land | -0.1 | 0.0 | -6.7 | -0.3 | -0.3 | -4.6 | 0.0 | 0.0 | 0.0 |
| Groundwater Pumping Cost | -0.3 | -0.3 | -0.4 | 1.0 | 1.0 | -4.5 | -0.2 | -0.2 | -0.2 |
| Irrigation Cost | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| CVP Water Cost | -0.3 | 1.7 | 3.6 | -5.1 | -1.0 | 4.6 | -0.1 | -0.1 | -0.7 |
| Higher Crop Prices | 0.0 | 0.0 | 1.9 | 0.1 | 0.1 | 1.0 | 0.0 | 0.0 | 0.0 |
| **Net Change** | **-1.0** | **1.0** | **-1.9** | **-4.6** | **-0.5** | **-3.8** | **-0.6** | **-0.6** | **-1.2** |
| **San Joaquin River** | | | | | | | | | |
| Fallowed Land | 0.0 | 0.0 | -0.1 | -0.2 | -0.2 | -0.2 | 0.0 | 0.0 | 0.0 |
| Groundwater Pumping Cost | 0.0 | 0.0 | -10.3 | -7.4 | 0.2 | -14.1 | -1.0 | -1.0 | -1.0 |
| Irrigation Cost | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 |
| CVP Water Cost | 1.0 | 4.0 | 2.3 | 7.9 | 6.1 | 6.2 | -5.9 | -5.9 | -7.5 |
| Higher Crop Prices | 0.1 | 0.0 | 2.5 | 0.2 | 0.2 | 1.0 | 0.0 | 0.0 | 0.0 |
| **Net Change** | **0.9** | **3.9** | **-5.7** | **0.4** | **6.1** | **-7.3** | **-7.0** | **-7.0** | **-8.6** |
| **Tulare Lake** | | | | | | | | | |
| Fallowed Land | 0.0 | 0.0 | 0.0 | -0.1 | -0.1 | -0.1 | 0.0 | 0.0 | 0.0 |
| Groundwater Pumping Cost | 0.1 | 0.1 | 0.1 | 1.0 | 1.0 | 1.0 | -3.2 | -3.2 | -3.2 |
| Irrigation Cost | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CVP Water Cost | -2.3 | -1.2 | -5.7 | -3.1 | -2.1 | -6.4 | -0.9 | -0.9 | -2.3 |
| Higher Crop Prices | 0.0 | 0.0 | 1.4 | 0.1 | 0.1 | 0.4 | 0.0 | 0.0 | 0.0 |
| **Net Change** | **-2.1** | **-1.1** | **-4.2** | **-2.1** | **-1.1** | **-5.1** | **-4.1** | **-4.1** | **-5.5** |
| **San Felipe** | | | | | | | | | |
| Fallowed Land | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Groundwater Pumping Cost | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Irrigation Cost | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CVP Water Cost | -0.2 | 0.0 | -0.6 | -0.5 | -0.2 | -0.9 | 0.0 | 0.0 | -0.1 |
| Higher Crop Prices | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Net Change** | **-0.2** | **0.0** | **-0.6** | **-0.5** | **-0.2** | **-0.9** | **0.0** | **0.0** | **-0.1** |
| **Total** | | | | | | | | | |
| Fallowed Land | -0.1 | -0.1 | -6.9 | -0.6 | -0.6 | -4.9 | 0.0 | 0.0 | 0.0 |
| Groundwater Pumping Cost | -0.2 | -0.2 | -10.5 | -5.3 | 2.2 | -17.6 | -4.4 | -4.4 | -4.4 |
| Irrigation Cost | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| CVP Water Cost | -1.6 | 4.5 | 0.2 | -0.3 | 3.1 | 4.5 | -6.9 | -6.8 | -10.5 |
| Higher Crop Prices | 0.1 | 0.1 | 5.8 | 0.4 | 0.4 | 2.3 | 0.0 | 0.0 | 0.0 |
| **Net Change** | **-2.3** | **3.7** | **-11.9** | **-6.3** | **4.6** | **-16.1** | **-11.7** | **-11.7** | **-15.3** |

Note: A negative value in a cost category represents an increase in cost that produces a decrease in net revenue

**TABLE 16**
**IRRIGATION WATER APPLIED BY REGION (1000 AF)**

| Region | Average Preferred Alternative | Change Compared to Average | | | Wet Preferred Alternative | Change Compared to Wet PA | | | Dry Preferred Alternative | Change Compared to Dry PA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Average | Wet | Dry | | Average | Wet | Dry | | Average | Wet | Dry |
| | | followed by Average | | | | followed by Wet | | | | followed by Dry | | |
| **Sacramento River** | | | | | | | | | | | | |
| CVP Water* | 625.9 | -27.6 | -23.4 | -243.5 | 694.3 | -2.4 | -2.6 | -305.5 | 402.1 | -20.3 | -20.3 | -20.4 |
| Groundwater | 2,621.3 | 10.5 | 10.7 | 11.2 | 2,456.9 | -24.5 | -24.3 | 114.7 | 3,261.6 | 4.1 | 4.2 | 4.0 |
| | | | | | | | | | | | | |
| **San Joaquin River** | | | | | | | | | | | | |
| CVP Water* | 960.2 | -8.7 | -9.0 | -269.0 | 1,226.6 | -226.3 | -21.0 | -378.7 | 506 | -17.5 | -17.5 | -17.5 |
| Groundwater | 3,606.2 | 3.3 | 3.5 | 260.0 | 2,974.2 | 215.1 | 10.3 | 366.8 | 4723 | 12.0 | 12.0 | 12.0 |
| | | | | | | | | | | | | |
| **Tulare Lake** | | | | | | | | | | | | |
| CVP Water* | 919.5 | 1.9 | 2.0 | 2.0 | 967.3 | 3.7 | 3.8 | 3.6 | 685.3 | 0.1 | 0.1 | 0.0 |
| Groundwater | 3,369.0 | -1.8 | -2.0 | -2.0 | 2,683.5 | -7.7 | -7.7 | -7.5 | 4,542.9 | 0.0400 | 0.0400 | 0.0400 |
| | | | | | | | | | | | | |
| **San Felipe** | | | | | | | | | | | | |
| CVP Water* | 71.0 | 0.0 | 0.0 | 0.0 | 71.0 | 0.0 | 0.0 | 0.0 | 71.0 | 0.0 | 0.0 | 0.0 |
| Groundwater | na | na | na | na | na | na | na | na | na | na | na | na |
| | | | | | | | | | | | | |
| **Total** | | | | | | | | | | | | |
| CVP Water* | 2,505.5 | -34.4 | -30.4 | -510.5 | 2,888.2 | -224.9 | -19.9 | -680.6 | 1,593.9 | -37.7 | -37.8 | -37.8 |
| Groundwater | 9,596.5 | 11.9 | 12.3 | 269.2 | 8,114.6 | 182.8 | -21.6 | 474.0 | 12,527.1 | 16.1 | 16.2 | 16.1 |

*CVP water applied is project water only. It excludes exchange contract delivery and the base supply portion of settlement contracts.

TABLE 17 IRRIGATED ACREAGE BY SUBREGION

| CVPM Subregion | Crop Category | Preferred Alternative Average | Changes Compared to Average P | | | Preferred Alternative Wet | Changes Compared to Wet PA | | | Preferred Alternative Dry | Changes Compared to Dry PA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Average | Wet | Dry | | Average | Wet | Dry | | Average | Wet | Dry |
| | | | Followed by Average | | | | Followed by Wet | | | | Followed by Dry | | |
| 1 | Pasture | 18.3 | -1.2 | -0.3 | -0.1 | 18.3 | -1.5 | -1.5 | -1.5 | 18.1 | -1.8 | -1.8 | -1.8 |
| | Alfalfa | 0.9 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 1.2 | 0.0 | 0.0 | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 3.8 | 0.0 | 0.0 | 0.0 | 3.8 | 0.0 | 0.0 | 0.0 | 3.8 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 2.4 | 0.0 | 0.0 | 0.0 | 2.4 | 0.0 | 0.0 | 0.0 | 2.4 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **26.6** | **-1.3** | **-0.3** | **-0.1** | **26.5** | **-1.6** | **-1.6** | **-1.6** | **26.3** | **-1.9** | **-1.9** | **-1.9** |
| 2 | Pasture | 34.1 | 0.0 | 0.0 | -3.6 | 33.9 | 0.0 | 0.0 | -5.9 | 33.1 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 9.5 | 0.0 | 0.0 | -0.3 | 9.5 | 0.0 | 0.0 | -0.6 | 9.4 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 4.0 | 0.0 | 0.0 | 0.0 | 4.0 | 0.0 | 0.0 | -0.1 | 4.0 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 17.3 | 0.0 | 0.0 | -0.5 | 17.2 | 0.0 | 0.0 | -0.7 | 17.1 | 0.0 | 0.0 | 0.0 |
| | Rice | 4.5 | 0.0 | 0.0 | -0.2 | 4.5 | 0.0 | 0.0 | -0.3 | 4.5 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 15.5 | 0.0 | 0.0 | 0.0 | 15.5 | 0.0 | 0.0 | 0.0 | 15.5 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 86.0 | 0.0 | 0.0 | -0.1 | 86.0 | 0.0 | 0.0 | 0.0 | 86.0 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 14.0 | 0.0 | 0.0 | -0.2 | 13.9 | 0.0 | 0.0 | -0.6 | 13.7 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 10.2 | 0.0 | 0.0 | 0.0 | 10.2 | 0.0 | 0.0 | 0.0 | 10.2 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **195.0** | **0.0** | **0.0** | **-4.9** | **194.7** | **0.0** | **0.0** | **-8.2** | **193.5** | **0.0** | **0.0** | **0.0** |
| 3 | Pasture | 7.8 | 0.0 | 0.0 | 0.0 | 7.9 | 0.0 | 0.0 | 0.0 | 7.5 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 18.2 | 0.0 | 0.0 | 0.0 | 18.3 | 0.0 | 0.0 | 0.0 | 18.0 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 9.9 | 0.0 | 0.0 | 0.0 | 9.9 | 0.0 | 0.0 | 0.0 | 9.8 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 15.7 | 0.0 | 0.0 | 0.0 | 15.8 | 0.0 | 0.0 | 0.0 | 15.5 | 0.0 | 0.0 | 0.0 |
| | Rice | 138.9 | 0.0 | 0.0 | 0.0 | 139.5 | 0.0 | 0.0 | 0.0 | 136.7 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 25.2 | 0.0 | 0.0 | 0.0 | 25.2 | 0.0 | 0.0 | 0.0 | 25.2 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 25.9 | 0.0 | 0.0 | 0.0 | 25.9 | 0.0 | 0.0 | 0.0 | 25.8 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 17.8 | 0.0 | 0.0 | 0.0 | 17.8 | 0.0 | 0.0 | 0.0 | 17.8 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 30.5 | 0.0 | 0.0 | 0.0 | 30.6 | 0.0 | 0.0 | 0.0 | 29.8 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **289.8** | **0.0** | **0.0** | **0.0** | **290.7** | **0.0** | **0.0** | **0.0** | **286.2** | **0.0** | **0.0** | **0.0** |
| 3B | Pasture | 5.7 | 0.0 | 0.0 | -5.7 | 5.8 | 0.1 | 0.1 | -1.5 | 4.3 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 10.1 | 0.0 | 0.0 | -10.1 | 10.2 | 0.1 | 0.1 | -2.6 | 7.6 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 5.6 | 0.0 | 0.0 | -5.3 | 5.6 | 0.0 | 0.0 | -2.8 | 5.1 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 13.4 | 0.0 | 0.0 | -13.4 | 13.5 | 0.0 | 0.0 | -13.5 | 10.4 | 0.0 | 0.0 | 0.0 |
| | Rice | 9.6 | 0.0 | 0.0 | -9.6 | 9.7 | 0.1 | 0.1 | -9.7 | 6.2 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 0.6 | 0.0 | 0.0 | -0.1 | 0.6 | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 6.1 | 0.0 | 0.0 | -3.8 | 6.1 | 0.0 | 0.0 | -1.8 | 5.7 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 26.9 | 0.0 | 0.0 | -3.3 | 26.9 | 0.0 | 0.0 | 0.0 | 26.9 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 8.5 | 0.0 | 0.0 | -8.5 | 8.6 | 0.0 | 0.0 | -8.6 | 6.2 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 1.0 | 0.0 | 0.0 | -0.1 | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **87.6** | **0.0** | **0.0** | **-59.9** | **87.9** | **0.3** | **0.3** | **-40.4** | **74.0** | **0.0** | **0.0** | **0.0** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pasture | 1.2 | 0.0 | 0.0 | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 6.8 | 0.0 | 0.0 | 0.0 | 6.8 | 0.0 | 0.0 | 0.0 | 6.8 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 10.3 | 0.0 | 0.0 | 0.0 | 10.3 | 0.0 | 0.0 | 0.0 | 10.3 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 40.1 | 0.0 | 0.0 | 0.0 | 40.1 | 0.0 | 0.0 | 0.0 | 39.8 | 0.0 | 0.0 | 0.0 |
| 4 | Rice | 87.8 | 0.0 | 0.0 | 0.0 | 87.9 | 0.0 | 0.0 | 0.0 | 87.1 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 17.1 | 0.0 | 0.0 | 0.0 | 17.1 | 0.0 | 0.0 | 0.0 | 17.1 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 34.1 | 0.0 | 0.0 | 0.0 | 34.1 | 0.0 | 0.0 | 0.0 | 34.0 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 30.6 | 0.0 | 0.0 | 0.0 | 30.6 | 0.0 | 0.0 | 0.0 | 30.6 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 47.5 | 0.0 | 0.0 | 0.0 | 47.6 | 0.0 | 0.0 | 0.0 | 46.8 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **275.3** | **0.0** | **0.0** | **0.0** | **275.7** | **0.0** | **0.0** | **-0.1** | **273.6** | **0.0** | **0.0** | **0.0** |
| | Pasture | 21.4 | 0.0 | 0.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.0 | 21.0 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 4.7 | 0.0 | 0.0 | 0.0 | 4.7 | 0.0 | 0.0 | 0.0 | 4.7 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 2.0 | 0.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 15.4 | 0.0 | 0.0 | 0.0 | 15.4 | 0.0 | 0.0 | 0.0 | 15.4 | 0.0 | 0.0 | 0.0 |
| | Rice | 166.0 | 0.0 | 0.0 | 0.0 | 166.6 | -0.1 | -0.1 | -0.1 | 165.2 | -0.1 | -0.1 | -0.1 |
| 5 | Truck Crops | 6.6 | 0.0 | 0.0 | 0.0 | 6.6 | 0.0 | 0.0 | 0.0 | 6.6 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 1.6 | 0.0 | 0.0 | 0.0 | 1.6 | 0.0 | 0.0 | 0.0 | 1.6 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 121.6 | 0.0 | 0.0 | 0.0 | 121.6 | 0.0 | 0.0 | 0.0 | 121.6 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 22.3 | 0.0 | 0.0 | 0.0 | 22.4 | 0.0 | 0.0 | 0.0 | 21.9 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 2.5 | 0.0 | 0.0 | 0.0 | 2.5 | 0.0 | 0.0 | 0.0 | 2.5 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **364.1** | **0.0** | **0.0** | **0.0** | **364.9** | **-0.2** | **-0.2** | **-0.1** | **362.4** | **-0.2** | **-0.2** | **-0.2** |
| | Pasture | 12.1 | 0.0 | 0.0 | 0.0 | 12.5 | -0.4 | -0.4 | -0.4 | 11.8 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 28.7 | 0.0 | 0.0 | 0.1 | 29.0 | -0.3 | -0.3 | -0.3 | 28.6 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 21.2 | 0.0 | 0.0 | 0.0 | 21.2 | -0.1 | -0.1 | -0.1 | 21.1 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 59.4 | 0.0 | 0.0 | 0.0 | 59.9 | -0.5 | -0.5 | -0.5 | 59.1 | 0.0 | 0.0 | 0.0 |
| | Rice | 12.9 | 0.0 | 0.0 | 0.0 | 13.1 | -0.2 | -0.2 | -0.2 | 12.8 | 0.0 | 0.0 | 0.0 |
| 6 | Truck Crops | 3.4 | 0.0 | 0.0 | 0.0 | 3.4 | 0.0 | 0.0 | 0.0 | 3.4 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 45.8 | 0.0 | 0.0 | 0.0 | 45.9 | -0.1 | -0.1 | -0.1 | 45.7 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 24.6 | 0.0 | 0.0 | 0.0 | 24.6 | 0.0 | 0.0 | 0.0 | 24.6 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 64.3 | 0.0 | 0.0 | 0.0 | 64.6 | -0.4 | -0.4 | -0.4 | 63.3 | 0.2 | 0.2 | 0.2 |
| | Grapes | 8.0 | 0.0 | 0.0 | 0.0 | 8.0 | 0.0 | 0.0 | 0.0 | 8.0 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **280.2** | **0.0** | **0.0** | **0.0** | **282.2** | **-1.9** | **-1.9** | **-1.8** | **278.4** | **0.2** | **0.2** | **0.2** |
| | Pasture | 14.5 | 0.0 | 0.0 | 0.0 | 14.5 | 0.0 | 0.0 | 0.0 | 14.2 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 3.1 | 0.0 | 0.0 | 0.0 | 3.1 | 0.0 | 0.0 | 0.0 | 3.1 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 2.5 | 0.0 | 0.0 | 0.0 | 2.5 | 0.0 | 0.0 | 0.0 | 2.5 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 3.8 | 0.0 | 0.0 | 0.0 | 3.8 | 0.0 | 0.0 | 0.0 | 3.8 | 0.0 | 0.0 | 0.0 |
| | Rice | 48.3 | 0.0 | 0.0 | 0.0 | 48.3 | 0.0 | 0.0 | 0.0 | 47.9 | 0.0 | 0.0 | 0.0 |
| 7 | Truck Crops | 0.3 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 0.5 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 8.9 | 0.0 | 0.0 | 0.0 | 8.9 | 0.0 | 0.0 | 0.0 | 8.9 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 9.4 | 0.0 | 0.0 | 0.0 | 9.3 | 0.0 | 0.0 | 0.0 | 9.2 | 0.0 | 0.0 | 0.0 |
| | Grapes | 0.2 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **91.4** | **0.0** | **0.0** | **0.0** | **91.5** | **0.0** | **0.0** | **0.0** | **90.5** | **0.0** | **0.0** | **0.0** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | Pasture | 47.7 | 0.0 | 0.0 | 0.0 | 47.6 | 0.0 | 0.0 | 0.0 | 46.9 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 12.3 | 0.0 | 0.0 | 0.0 | 12.3 | 0.0 | 0.0 | 0.0 | 12.2 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 12.8 | 0.0 | 0.0 | 0.0 | 12.8 | 0.0 | 0.0 | 0.0 | 12.8 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 42.7 | 0.0 | 0.0 | 0.0 | 42.7 | 0.0 | 0.0 | 0.0 | 42.5 | 0.0 | 0.0 | 0.0 |
| | Rice | 4.5 | 0.0 | 0.0 | 0.0 | 4.5 | 0.0 | 0.0 | 0.0 | 4.5 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 17.1 | 0.0 | 0.0 | 0.0 | 17.1 | 0.0 | 0.0 | 0.0 | 17.1 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 12.9 | 0.0 | 0.0 | 0.0 | 12.9 | 0.0 | 0.0 | 0.0 | 12.9 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 46.9 | 0.0 | 0.0 | 0.0 | 46.9 | 0.0 | 0.0 | 0.0 | 46.9 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 29.0 | 0.0 | 0.0 | 0.0 | 29.1 | 0.0 | 0.0 | 0.0 | 28.2 | 0.0 | 0.0 | 0.0 |
| | Grapes | 58.9 | 0.0 | 0.0 | 0.0 | 58.9 | 0.0 | 0.0 | 0.0 | 58.9 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **284.8** | **0.0** | **0.0** | **0.0** | **284.9** | **0.0** | **0.0** | **0.0** | **282.8** | **0.0** | **0.0** | **0.0** |
| 9 | Pasture | 24.6 | -0.2 | -0.2 | -0.1 | 24.6 | -0.4 | -0.4 | -0.4 | 23.4 | 0.7 | 0.7 | 0.7 |
| | Alfalfa | 43.8 | -0.1 | -0.1 | 0.0 | 43.8 | -0.2 | -0.2 | -0.2 | 43.1 | 0.4 | 0.4 | 0.4 |
| | Sugar Beets | 28.6 | 0.0 | 0.0 | 0.0 | 28.6 | -0.1 | -0.1 | 0.0 | 28.5 | 0.1 | 0.1 | 0.1 |
| | Other Field Crops | 114.9 | -0.2 | -0.2 | -0.2 | 115.0 | -0.4 | -0.4 | -0.4 | 113.6 | 0.7 | 0.7 | 0.7 |
| | Rice | 0.9 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 46.0 | 0.0 | 0.0 | 0.0 | 46.0 | 0.0 | 0.0 | 0.0 | 46.0 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 42.5 | 0.0 | 0.0 | 0.0 | 42.5 | 0.0 | 0.0 | 0.0 | 42.3 | 0.1 | 0.1 | 0.1 |
| | Deciduous Orchard | 21.3 | 0.0 | 0.0 | 0.0 | 21.3 | 0.0 | 0.0 | 0.0 | 21.3 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 96.8 | -0.1 | -0.1 | -0.1 | 97.5 | -0.3 | -0.3 | -0.3 | 93.7 | 1.0 | 1.0 | 1.0 |
| | Grapes | 5.8 | 0.0 | 0.0 | 0.0 | 5.8 | 0.0 | 0.0 | 0.0 | 5.8 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **425.0** | **-0.6** | **-0.6** | **-0.4** | **425.9** | **-1.5** | **-1.5** | **-1.4** | **418.4** | **3.0** | **3.0** | **3.0** |
| 10 | Pasture | 13.3 | 0.0 | 0.0 | -0.2 | 13.3 | 0.0 | 0.0 | 0.0 | 13.3 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 40.8 | 0.0 | 0.0 | -0.3 | 40.9 | -0.1 | 0.0 | -0.1 | 40.8 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 13.9 | 0.0 | 0.0 | 0.0 | 13.9 | 0.0 | 0.0 | 0.0 | 13.9 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 48.2 | 0.0 | 0.0 | -0.1 | 48.2 | 0.1 | 0.0 | 0.0 | 48.3 | 0.0 | 0.0 | 0.0 |
| | Rice | 2.9 | 0.0 | 0.0 | 0.0 | 2.9 | 0.0 | 0.0 | 0.0 | 2.9 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 112.9 | 0.0 | 0.0 | 0.0 | 112.9 | 0.0 | 0.0 | 0.0 | 113.0 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 40.2 | 0.0 | 0.0 | 0.0 | 40.2 | 0.0 | 0.0 | 0.0 | 40.2 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 36.6 | 0.0 | 0.0 | 0.0 | 36.6 | 0.0 | 0.0 | 0.0 | 36.6 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 14.0 | 0.0 | 0.0 | 0.0 | 14.0 | 0.1 | 0.0 | 0.1 | 14.0 | 0.0 | 0.0 | 0.0 |
| | Grapes | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 |
| | Cotton | 103.1 | 0.0 | 0.0 | -0.5 | 103.1 | -0.1 | 0.0 | -0.1 | 103.1 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **427.1** | **0.0** | **0.0** | **-1.1** | **427.2** | **-0.1** | **0.0** | **-0.1** | **427.1** | **0.0** | **0.0** | **0.0** |
| 11 | Pasture | 42.9 | 0.0 | 0.0 | 0.0 | 43.0 | 0.0 | 0.0 | 0.0 | 42.7 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 8.4 | 0.0 | 0.0 | 0.0 | 8.4 | 0.0 | 0.0 | 0.0 | 8.3 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 0.4 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 17.8 | 0.0 | 0.0 | 0.0 | 17.9 | 0.0 | 0.0 | 0.0 | 17.8 | 0.0 | 0.0 | 0.0 |
| | Rice | 4.4 | 0.0 | 0.0 | 0.0 | 4.4 | 0.0 | 0.0 | 0.0 | 4.4 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 6.3 | 0.0 | 0.0 | 0.0 | 6.3 | 0.0 | 0.0 | 0.0 | 6.3 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 0.8 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 80.8 | 0.0 | 0.0 | 0.0 | 80.8 | 0.0 | 0.0 | 0.0 | 80.8 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 1.8 | 0.0 | 0.0 | 0.0 | 1.8 | 0.0 | 0.0 | 0.0 | 1.8 | 0.0 | 0.0 | 0.0 |
| | Grapes | 10.4 | 0.0 | 0.0 | 0.0 | 10.4 | 0.0 | 0.0 | 0.0 | 10.4 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **174.0** | **0.0** | **0.0** | **0.0** | **174.2** | **0.0** | **0.0** | **0.0** | **173.7** | **0.0** | **0.0** | **0.0** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | Pasture | 18.3 | 0.0 | 0.0 | 0.0 | 18.0 | 0.0 | 0.0 | 0.0 | 18.0 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 18.2 | 0.0 | 0.0 | 0.0 | 18.1 | 0.0 | 0.0 | 0.0 | 18.1 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 41.2 | 0.0 | 0.0 | 0.0 | 41.0 | 0.0 | 0.0 | 0.0 | 41.0 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 3.0 | 0.0 | 0.0 | 0.0 | 3.0 | 0.0 | 0.0 | 0.0 | 3.0 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 94.0 | 0.0 | 0.0 | 0.0 | 94.0 | 0.0 | 0.0 | 0.0 | 94.0 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 10.0 | 0.0 | 0.0 | 0.0 | 10.0 | 0.0 | 0.0 | 0.0 | 9.9 | 0.0 | 0.0 | 0.0 |
| | Grapes | 14.0 | 0.0 | 0.0 | 0.0 | 14.0 | 0.0 | 0.0 | 0.0 | 14.0 | 0.0 | 0.0 | 0.0 |
| | Cotton | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **200.8** | **0.0** | **0.0** | **0.0** | **200.2** | **0.0** | **0.0** | **0.0** | **200.1** | **0.0** | **0.0** | **0.0** |
| 13 | Pasture | 39.6 | 0.0 | 0.0 | 0.0 | 39.9 | -0.2 | -0.2 | -0.3 | 39.5 | -0.3 | -0.3 | -0.3 |
| | Alfalfa | 41.8 | 0.0 | 0.0 | 0.1 | 42.1 | -0.2 | -0.2 | -0.2 | 41.8 | -0.2 | -0.2 | -0.2 |
| | Sugar Beets | 5.0 | 0.0 | 0.0 | 0.0 | 5.0 | 0.0 | 0.0 | 0.0 | 5.0 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 54.8 | 0.0 | 0.0 | 0.0 | 55.0 | -0.1 | -0.1 | -0.2 | 54.6 | -0.1 | -0.1 | -0.1 |
| | Rice | 3.9 | 0.0 | 0.0 | 0.0 | 3.9 | 0.0 | 0.0 | 0.0 | 3.9 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 18.0 | 0.0 | 0.0 | 0.0 | 18.0 | 0.0 | 0.0 | 0.0 | 18.0 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 7.0 | 0.0 | 0.0 | 0.0 | 7.0 | 0.0 | 0.0 | 0.0 | 7.0 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 135.0 | 0.0 | 0.0 | 0.0 | 135.0 | 0.0 | 0.0 | 0.0 | 135.0 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 46.9 | 0.0 | 0.0 | 0.0 | 47.2 | -0.1 | -0.1 | -0.1 | 46.4 | -0.1 | -0.1 | -0.1 |
| | Grapes | 99.0 | 0.0 | 0.0 | 0.0 | 99.0 | 0.0 | 0.0 | 0.0 | 99.0 | 0.0 | 0.0 | 0.0 |
| | Cotton | 71.8 | 0.0 | 0.0 | 0.0 | 72.1 | -0.2 | -0.2 | -0.3 | 71.6 | -0.2 | -0.2 | -0.2 |
| | Subtropical Orchard | 9.9 | 0.0 | 0.0 | 0.0 | 9.9 | 0.0 | 0.0 | 0.0 | 9.9 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **532.5** | **0.0** | **0.0** | **0.0** | **534.1** | **-0.9** | **-0.9** | **-1.1** | **531.6** | **-0.9** | **-0.9** | **-0.9** |
| 14 | Pasture | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 14.0 | 0.0 | 0.0 | 0.0 | 14.0 | 0.0 | 0.0 | 0.0 | 13.4 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 4.8 | 0.0 | 0.0 | 0.0 | 4.8 | 0.0 | 0.0 | 0.0 | 4.8 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 18.4 | 0.0 | 0.0 | 0.0 | 18.3 | 0.0 | 0.0 | 0.0 | 17.9 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 136.4 | 0.0 | 0.0 | 0.0 | 136.4 | 0.0 | 0.0 | 0.0 | 136.2 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 77.0 | 0.0 | 0.0 | 0.1 | 77.0 | 0.0 | 0.0 | 0.0 | 76.2 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 24.9 | 0.0 | 0.0 | 0.0 | 24.9 | 0.0 | 0.0 | 0.0 | 24.9 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 10.4 | 0.0 | 0.0 | 0.0 | 10.4 | 0.0 | 0.0 | 0.0 | 9.7 | 0.0 | 0.0 | 0.0 |
| | Grapes | 7.0 | 0.0 | 0.0 | 0.0 | 7.0 | 0.0 | 0.0 | 0.0 | 7.0 | 0.0 | 0.0 | 0.0 |
| | Cotton | 206.5 | 0.0 | 0.0 | -0.1 | 206.6 | 0.0 | 0.0 | 0.0 | 198.8 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **500.4** | **0.0** | **0.0** | **0.0** | **500.5** | **0.0** | **0.0** | **0.0** | **489.9** | **0.0** | **0.0** | **0.0** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | Pasture | 3.9 | 0.0 | 0.0 | 0.0 | 3.9 | 0.0 | 0.0 | 0.0 | 3.7 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 83.1 | 0.0 | 0.0 | 0.2 | 83.4 | 0.0 | 0.0 | 0.1 | 80.6 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 5.0 | 0.0 | 0.0 | 0.0 | 5.0 | 0.0 | 0.0 | 0.0 | 5.0 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 86.0 | 0.0 | 0.0 | 0.0 | 86.1 | 0.0 | 0.0 | 0.0 | 84.2 | 0.0 | 0.0 | 0.0 |
| | Rice | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 12.0 | 0.0 | 0.0 | 0.0 | 12.0 | 0.0 | 0.0 | 0.0 | 12.0 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 2.0 | 0.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 38.0 | 0.0 | 0.0 | 0.0 | 38.0 | 0.0 | 0.0 | 0.0 | 38.0 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 71.0 | 0.0 | 0.0 | 0.0 | 71.6 | 0.0 | 0.0 | 0.0 | 67.9 | 0.0 | 0.0 | 0.0 |
| | Grapes | 56.0 | 0.0 | 0.0 | 0.0 | 56.0 | 0.0 | 0.0 | 0.0 | 56.0 | 0.0 | 0.0 | 0.0 |
| | Cotton | 242.1 | 0.0 | 0.0 | -0.2 | 242.7 | 0.0 | 0.0 | -0.1 | 235.5 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **600.1** | **0.0** | **0.0** | **-0.1** | **601.7** | **0.0** | **0.0** | **0.0** | **585.9** | **0.0** | **0.0** | **0.0** |
| 16 | Pasture | 6.2 | 0.0 | 0.0 | 0.0 | 6.3 | -0.2 | -0.2 | -0.1 | 6.1 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 5.1 | 0.0 | 0.0 | 0.0 | 5.2 | -0.1 | -0.1 | -0.1 | 5.1 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 6.1 | 0.0 | 0.0 | 0.0 | 6.1 | -0.1 | -0.1 | -0.1 | 6.0 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 5.0 | 0.0 | 0.0 | 0.0 | 5.0 | 0.0 | 0.0 | 0.0 | 5.0 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 16.0 | 0.0 | 0.0 | 0.0 | 16.0 | 0.0 | 0.0 | 0.0 | 16.0 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 4.0 | 0.0 | 0.0 | 0.0 | 4.1 | 0.0 | 0.0 | 0.0 | 4.0 | 0.0 | 0.0 | 0.0 |
| | Grapes | 55.0 | 0.0 | 0.0 | 0.0 | 55.0 | 0.0 | 0.0 | 0.0 | 55.0 | 0.0 | 0.0 | 0.0 |
| | Cotton | 5.0 | 0.0 | 0.0 | 0.0 | 5.1 | 0.0 | 0.0 | 0.0 | 5.0 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 9.0 | 0.0 | 0.0 | 0.0 | 9.0 | 0.0 | 0.0 | 0.0 | 9.0 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **111.4** | **-0.1** | **-0.1** | **0.0** | **111.8** | **-0.4** | **-0.4** | **-0.4** | **111.3** | **-0.1** | **-0.1** | **-0.1** |
| 17 | Pasture | 3.0 | 0.0 | 0.0 | 0.0 | 3.0 | 0.0 | 0.0 | 0.0 | 2.3 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 5.0 | 0.0 | 0.0 | 0.0 | 5.0 | 0.0 | 0.0 | 0.0 | 4.0 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 8.0 | 0.0 | 0.0 | 0.0 | 8.0 | 0.0 | 0.0 | 0.0 | 7.1 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 10.0 | 0.0 | 0.0 | 0.0 | 10.0 | 0.0 | 0.0 | 0.0 | 10.0 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 73.0 | 0.0 | 0.0 | 0.0 | 73.0 | 0.0 | 0.0 | 0.0 | 73.0 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 6.0 | 0.0 | 0.0 | 0.0 | 6.0 | 0.0 | 0.0 | 0.0 | 5.3 | 0.0 | 0.0 | 0.0 |
| | Grapes | 109.0 | 0.0 | 0.0 | 0.0 | 109.0 | 0.0 | 0.0 | 0.0 | 109.0 | 0.0 | 0.0 | 0.0 |
| | Cotton | 10.0 | 0.0 | 0.0 | 0.0 | 10.0 | 0.0 | 0.0 | 0.0 | 8.7 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 35.0 | 0.0 | 0.0 | 0.0 | 35.0 | 0.0 | 0.0 | 0.0 | 35.0 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **260.1** | **0.0** | **0.0** | **0.0** | **260.3** | **0.0** | **0.0** | **0.0** | **255.3** | **0.0** | **0.0** | **0.0** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | Pasture | 4.0 | 0.0 | 0.0 | 0.0 | 4.1 | 0.0 | 0.0 | 0.0 | 3.7 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 62.2 | 0.0 | 0.0 | 0.1 | 62.8 | -0.3 | -0.3 | -0.2 | 59.0 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 1.9 | 0.0 | 0.0 | 0.0 | 1.9 | 0.0 | 0.0 | 0.0 | 1.9 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 78.1 | 0.0 | 0.0 | -0.1 | 78.5 | -0.2 | -0.2 | -0.2 | 75.3 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 13.0 | 0.0 | 0.0 | 0.0 | 13.0 | 0.0 | 0.0 | 0.0 | 13.0 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 69.0 | 0.0 | 0.0 | 0.0 | 69.0 | 0.0 | 0.0 | 0.0 | 69.0 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 41.0 | 0.0 | 0.0 | 0.0 | 41.4 | -0.1 | -0.1 | -0.1 | 38.8 | 0.1 | 0.1 | 0.1 |
| | Grapes | 56.0 | 0.0 | 0.0 | 0.0 | 56.0 | 0.0 | 0.0 | 0.0 | 56.0 | 0.0 | 0.0 | 0.0 |
| | Cotton | 170.3 | 0.0 | 0.0 | -0.1 | 171.2 | -0.5 | -0.5 | -0.5 | 163.7 | 0.0 | 0.0 | 0.1 |
| | Subtropical Orchard | 97.0 | 0.0 | 0.0 | 0.0 | 97.0 | 0.0 | 0.0 | 0.0 | 97.0 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **592.5** | **0.0** | **0.0** | **-0.1** | **594.9** | **-1.2** | **-1.2** | **-1.2** | **577.2** | **0.1** | **0.1** | **0.1** |
| 19 | Pasture | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 25.8 | 0.0 | 0.0 | 0.0 | 25.9 | 0.0 | 0.0 | 0.0 | 25.2 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 4.9 | 0.0 | 0.0 | 0.0 | 5.0 | 0.0 | 0.0 | 0.0 | 4.9 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 6.7 | 0.0 | 0.0 | 0.0 | 6.7 | 0.0 | 0.0 | 0.0 | 6.7 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 24.0 | 0.0 | 0.0 | 0.0 | 24.0 | 0.0 | 0.0 | 0.0 | 24.0 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 1.7 | 0.0 | 0.0 | 0.0 | 1.7 | 0.0 | 0.0 | 0.0 | 1.7 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 50.9 | 0.0 | 0.0 | 0.0 | 50.9 | 0.0 | 0.0 | 0.0 | 50.9 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 7.6 | 0.0 | 0.0 | 0.0 | 7.6 | 0.0 | 0.0 | 0.0 | 7.2 | 0.0 | 0.0 | 0.0 |
| | Grapes | 10.0 | 0.0 | 0.0 | 0.0 | 10.0 | 0.0 | 0.0 | 0.0 | 10.0 | 0.0 | 0.0 | 0.0 |
| | Cotton | 117.9 | 0.0 | 0.0 | -0.1 | 117.8 | 0.0 | 0.0 | 0.0 | 115.1 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 4.0 | 0.0 | 0.0 | 0.0 | 4.0 | 0.0 | 0.0 | 0.0 | 4.0 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **253.6** | **0.0** | **0.0** | **0.0** | **253.6** | **0.0** | **0.0** | **0.0** | **249.7** | **0.0** | **0.0** | **0.0** |
| 20 | Pasture | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 12.0 | 0.0 | 0.0 | 0.0 | 12.1 | 0.0 | 0.0 | 0.0 | 11.0 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 0.5 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 3.0 | 0.0 | 0.0 | 0.0 | 3.0 | 0.0 | 0.0 | 0.0 | 2.9 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 41.0 | 0.0 | 0.0 | 0.0 | 41.0 | 0.0 | 0.0 | 0.0 | 40.9 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 0.3 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 52.0 | 0.0 | 0.0 | 0.0 | 52.0 | 0.0 | 0.0 | 0.0 | 52.0 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 |
| | Grapes | 33.0 | 0.0 | 0.0 | 0.0 | 33.0 | 0.0 | 0.0 | 0.0 | 33.0 | 0.0 | 0.0 | 0.0 |
| | Cotton | 33.0 | 0.0 | 0.0 | 0.0 | 33.1 | 0.0 | 0.0 | 0.0 | 30.8 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 27.0 | 0.0 | 0.0 | 0.0 | 27.0 | 0.0 | 0.0 | 0.0 | 27.0 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **202.8** | **0.0** | **0.0** | **0.0** | **203.0** | **0.0** | **0.0** | **0.0** | **199.3** | **0.0** | **0.0** | **0.0** |

TABLE 18 VALUE OF PRODUCTION BY SUBREGION (Million $)

| CVPM Subregion | Crop Category | Preferred Alternative Average | Changes Compared to Average PA: Average | Wet | Dry | Preferred Alternative Wet | Changes Compared to Wet PA: Average | Wet | Dry | Preferred Alternative Dry | Changes Compared to Dry PA: Average | Wet | Dry |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Followed by Average | | | | Followed by Wet | | | | Followed by Dry | | |
| 1 | Pasture | 2.7 | -0.2 | 0.0 | 0.0 | 2.6 | -0.2 | -0.2 | -0.2 | 2.6 | -0.3 | -0.3 | -0.3 |
| | Alfalfa | 0.5 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 0.5 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 4.0 | 0.0 | 0.0 | 0.0 | 4.0 | 0.0 | 0.0 | 0.0 | 4.0 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 0.7 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **8.4** | **-0.2** | **-0.1** | **0.0** | **8.3** | **-0.3** | **-0.3** | **-0.3** | **8.3** | **-0.3** | **-0.3** | **-0.3** |
| 2 | Pasture | 4.9 | 0.0 | 0.0 | -0.5 | 4.9 | 0.0 | 0.0 | -0.8 | 4.8 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 5.1 | 0.0 | 0.0 | -0.2 | 5.1 | 0.0 | 0.0 | -0.3 | 5.0 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 2.9 | 0.0 | 0.0 | 0.0 | 2.9 | 0.0 | 0.0 | 0.0 | 2.9 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 7.8 | 0.0 | 0.0 | -0.2 | 7.8 | 0.0 | 0.0 | -0.3 | 7.7 | 0.0 | 0.0 | 0.0 |
| | Rice | 3.8 | 0.0 | 0.0 | -0.1 | 3.8 | 0.0 | 0.0 | -0.3 | 3.8 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 55.1 | 0.0 | 0.0 | -0.1 | 55.1 | 0.0 | 0.0 | -0.1 | 55.1 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 91.3 | 0.0 | 0.0 | -0.1 | 91.3 | 0.0 | 0.0 | 0.0 | 91.3 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 4.0 | 0.0 | 0.0 | -0.1 | 3.9 | 0.0 | 0.0 | -0.2 | 3.9 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 14.6 | 0.0 | 0.0 | 0.0 | 14.6 | 0.0 | 0.0 | 0.0 | 14.6 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **189.5** | **0.0** | **0.0** | **-1.3** | **189.4** | **0.0** | **0.0** | **-2.1** | **189.1** | **0.0** | **0.0** | **0.0** |
| 3 | Pasture | 1.1 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 9.7 | 0.0 | 0.0 | 0.0 | 9.7 | 0.0 | 0.0 | 0.0 | 9.6 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 7.3 | 0.0 | 0.0 | 0.0 | 7.3 | 0.0 | 0.0 | 0.0 | 7.2 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 7.1 | 0.0 | 0.0 | 0.0 | 7.1 | 0.0 | 0.0 | 0.0 | 7.0 | 0.0 | 0.0 | 0.0 |
| | Rice | 118.1 | 0.0 | 0.0 | 0.0 | 118.6 | 0.0 | 0.0 | 0.0 | 116.2 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 89.6 | 0.0 | 0.0 | 0.0 | 89.6 | 0.0 | 0.0 | 0.0 | 89.6 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 37.9 | 0.0 | 0.0 | 0.0 | 38.0 | 0.0 | 0.0 | 0.0 | 37.9 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 18.9 | 0.0 | 0.0 | 0.0 | 18.9 | 0.0 | 0.0 | 0.0 | 18.9 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 8.7 | 0.0 | 0.0 | 0.0 | 8.7 | 0.0 | 0.0 | 0.0 | 8.5 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **298.4** | **0.0** | **0.0** | **0.0** | **299.0** | **0.0** | **0.0** | **0.0** | **295.9** | **0.0** | **0.0** | **0.0** |
| 3B | Pasture | 0.8 | 0.0 | 0.0 | -0.8 | 0.8 | 0.0 | 0.0 | -0.2 | 0.6 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 5.4 | 0.0 | 0.0 | -5.4 | 5.4 | 0.0 | 0.0 | -1.4 | 4.1 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 4.1 | 0.0 | 0.0 | -3.9 | 4.1 | 0.0 | 0.0 | -2.0 | 3.8 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 6.1 | 0.0 | 0.0 | -6.0 | 6.1 | 0.0 | 0.0 | -6.1 | 4.7 | 0.0 | 0.0 | 0.0 |
| | Rice | 8.2 | 0.0 | 0.0 | -8.2 | 8.2 | 0.0 | 0.0 | -8.2 | 5.2 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 2.0 | 0.0 | 0.0 | -0.2 | 2.0 | 0.0 | 0.0 | -0.1 | 2.0 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 8.9 | 0.0 | 0.0 | -5.6 | 8.9 | 0.0 | 0.0 | -2.7 | 8.4 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 28.6 | 0.0 | 0.0 | -3.5 | 28.6 | 0.0 | 0.0 | 0.0 | 28.6 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 2.4 | 0.0 | 0.0 | -2.4 | 2.4 | 0.0 | 0.0 | -2.4 | 1.8 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 1.4 | 0.0 | 0.0 | -0.1 | 1.4 | 0.0 | 0.0 | 0.0 | 1.4 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **67.9** | **0.0** | **0.0** | **-36.2** | **68.1** | **0.1** | **0.1** | **-23.1** | **60.5** | **0.0** | **0.0** | **0.0** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pasture | 0.2 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 3.6 | 0.0 | 0.0 | 0.0 | 3.7 | 0.0 | 0.0 | 0.0 | 3.6 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 7.5 | 0.0 | 0.0 | 0.0 | 7.5 | 0.0 | 0.0 | 0.0 | 7.5 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 18.0 | 0.0 | 0.0 | 0.0 | 18.1 | 0.0 | 0.0 | 0.0 | 17.9 | 0.0 | 0.0 | 0.0 |
| 4 | Rice | 74.6 | 0.0 | 0.0 | 0.0 | 74.8 | 0.0 | 0.0 | 0.0 | 74.1 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 60.8 | 0.0 | 0.0 | 0.0 | 60.8 | 0.0 | 0.0 | 0.0 | 60.8 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 49.9 | 0.0 | 0.0 | 0.0 | 49.9 | 0.0 | 0.0 | 0.0 | 49.9 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 32.5 | 0.0 | 0.0 | 0.0 | 32.5 | 0.0 | 0.0 | 0.0 | 32.5 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 13.5 | 0.0 | 0.0 | 0.0 | 13.5 | 0.0 | 0.0 | 0.0 | 13.3 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **260.7** | **0.0** | **0.0** | **0.0** | **260.9** | **0.0** | **0.0** | **0.0** | **259.7** | **0.0** | **0.0** | **0.0** |
| | Pasture | 3.1 | 0.0 | 0.0 | 0.0 | 3.1 | 0.0 | 0.0 | 0.0 | 3.0 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 2.5 | 0.0 | 0.0 | 0.0 | 2.5 | 0.0 | 0.0 | 0.0 | 2.5 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 1.5 | 0.0 | 0.0 | 0.0 | 1.5 | 0.0 | 0.0 | 0.0 | 1.5 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 6.9 | 0.0 | 0.0 | 0.0 | 6.9 | 0.0 | 0.0 | 0.0 | 6.9 | 0.0 | 0.0 | 0.0 |
| | Rice | 141.2 | 0.0 | 0.0 | 0.0 | 141.7 | -0.1 | -0.1 | -0.1 | 140.5 | -0.1 | -0.1 | -0.1 |
| 5 | Truck Crops | 23.5 | 0.0 | 0.0 | 0.0 | 23.5 | 0.0 | 0.0 | 0.0 | 23.5 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 2.3 | 0.0 | 0.0 | 0.0 | 2.3 | 0.0 | 0.0 | 0.0 | 2.3 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 129.1 | 0.0 | 0.0 | 0.0 | 129.1 | 0.0 | 0.0 | 0.0 | 129.1 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 6.3 | 0.0 | 0.0 | 0.0 | 6.3 | 0.0 | 0.0 | 0.0 | 6.2 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 3.6 | 0.0 | 0.0 | 0.0 | 3.6 | 0.0 | 0.0 | 0.0 | 3.6 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **320.0** | **0.0** | **0.0** | **0.0** | **320.5** | **-0.1** | **-0.1** | **-0.1** | **319.1** | **-0.1** | **-0.1** | **-0.1** |
| | Pasture | 1.7 | 0.0 | 0.0 | 0.0 | 1.8 | -0.1 | -0.1 | -0.1 | 1.7 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 16.8 | 0.0 | 0.0 | 0.0 | 17.0 | -0.2 | -0.2 | -0.2 | 16.8 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 16.2 | 0.0 | 0.0 | 0.0 | 16.3 | -0.1 | -0.1 | 0.0 | 16.2 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 28.9 | 0.0 | 0.0 | 0.0 | 29.2 | -0.2 | -0.2 | -0.2 | 28.8 | 0.0 | 0.0 | 0.0 |
| | Rice | 10.6 | 0.0 | 0.0 | 0.0 | 10.8 | -0.2 | -0.2 | -0.2 | 10.5 | 0.0 | 0.0 | 0.0 |
| 6 | Truck Crops | 14.1 | 0.0 | 0.0 | 0.0 | 14.1 | 0.0 | 0.0 | 0.0 | 14.1 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 70.0 | 0.0 | 0.0 | 0.0 | 70.2 | -0.1 | -0.1 | -0.1 | 70.0 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 26.2 | 0.0 | 0.0 | 0.0 | 26.2 | 0.0 | 0.0 | 0.0 | 26.2 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 21.9 | 0.0 | 0.0 | 0.0 | 22.0 | -0.1 | -0.1 | -0.1 | 21.5 | 0.1 | 0.1 | 0.1 |
| | Grapes | 13.8 | 0.0 | 0.0 | 0.0 | 13.8 | 0.0 | 0.0 | 0.0 | 13.8 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **220.3** | **0.0** | **0.0** | **0.0** | **221.2** | **-0.9** | **-0.9** | **-0.9** | **219.6** | **0.0** | **0.0** | **0.0** |
| | Pasture | 2.1 | 0.0 | 0.0 | 0.0 | 2.1 | 0.0 | 0.0 | 0.0 | 2.1 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 1.8 | 0.0 | 0.0 | 0.0 | 1.8 | 0.0 | 0.0 | 0.0 | 1.8 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 1.9 | 0.0 | 0.0 | 0.0 | 1.9 | 0.0 | 0.0 | 0.0 | 1.9 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 1.8 | 0.0 | 0.0 | 0.0 | 1.8 | 0.0 | 0.0 | 0.0 | 1.8 | 0.0 | 0.0 | 0.0 |
| | Rice | 39.6 | 0.0 | 0.0 | 0.0 | 39.7 | 0.0 | 0.0 | 0.0 | 39.3 | 0.0 | 0.0 | 0.0 |
| 7 | Truck Crops | 1.2 | 0.0 | 0.0 | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 0.8 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 9.5 | 0.0 | 0.0 | 0.0 | 9.5 | 0.0 | 0.0 | 0.0 | 9.5 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 3.2 | 0.0 | 0.0 | 0.0 | 3.2 | 0.0 | 0.0 | 0.0 | 3.1 | 0.0 | 0.0 | 0.0 |
| | Grapes | 0.3 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **62.3** | **0.0** | **0.0** | **0.0** | **62.4** | **0.0** | **0.0** | **0.0** | **61.9** | **0.0** | **0.0** | **0.0** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | Pasture | 6.9 | 0.0 | 0.0 | 0.0 | 6.9 | 0.0 | 0.0 | 0.0 | 6.8 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 7.2 | 0.0 | 0.0 | 0.0 | 7.2 | 0.0 | 0.0 | 0.0 | 7.2 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 9.8 | 0.0 | 0.0 | 0.0 | 9.8 | 0.0 | 0.0 | 0.0 | 9.8 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 20.8 | 0.0 | 0.0 | 0.0 | 20.8 | 0.0 | 0.0 | 0.0 | 20.7 | 0.0 | 0.0 | 0.0 |
| | Rice | 3.7 | 0.0 | 0.0 | 0.0 | 3.7 | 0.0 | 0.0 | 0.0 | 3.7 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 70.9 | 0.0 | 0.0 | 0.0 | 70.9 | 0.0 | 0.0 | 0.0 | 70.9 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 19.8 | 0.0 | 0.0 | 0.0 | 19.8 | 0.0 | 0.0 | 0.0 | 19.7 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 49.9 | 0.0 | 0.0 | 0.0 | 49.9 | 0.0 | 0.0 | 0.0 | 49.9 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 9.2 | 0.0 | 0.0 | 0.0 | 9.2 | 0.0 | 0.0 | 0.0 | 8.9 | 0.0 | 0.0 | 0.0 |
| | Grapes | 101.7 | 0.0 | 0.0 | 0.0 | 101.7 | 0.0 | 0.0 | 0.0 | 101.7 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **299.9** | **0.0** | **0.0** | **0.0** | **300.0** | **0.0** | **0.0** | **0.0** | **299.3** | **0.0** | **0.0** | **0.0** |
| 9 | Pasture | 3.6 | 0.0 | 0.0 | 0.0 | 3.6 | -0.1 | -0.1 | -0.1 | 3.4 | 0.1 | 0.1 | 0.1 |
| | Alfalfa | 25.6 | -0.1 | -0.1 | 0.0 | 25.7 | -0.1 | -0.1 | -0.1 | 25.2 | 0.2 | 0.2 | 0.2 |
| | Sugar Beets | 22.0 | 0.0 | 0.0 | 0.0 | 22.0 | 0.0 | 0.0 | 0.0 | 21.9 | 0.1 | 0.1 | 0.1 |
| | Other Field Crops | 55.9 | -0.1 | -0.1 | -0.1 | 56.0 | -0.2 | -0.2 | -0.2 | 55.3 | 0.3 | 0.3 | 0.3 |
| | Rice | 0.7 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 190.8 | 0.0 | 0.0 | 0.0 | 190.8 | 0.0 | 0.0 | 0.0 | 190.6 | 0.1 | 0.1 | 0.1 |
| | Tomatoes | 64.9 | 0.0 | 0.0 | 0.0 | 65.0 | -0.1 | -0.1 | 0.0 | 64.8 | 0.1 | 0.1 | 0.1 |
| | Deciduous Orchard | 22.7 | 0.0 | 0.0 | 0.0 | 22.7 | 0.0 | 0.0 | 0.0 | 22.7 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 30.7 | 0.0 | 0.0 | 0.0 | 30.9 | -0.1 | -0.1 | -0.1 | 29.7 | 0.3 | 0.3 | 0.3 |
| | Grapes | 10.0 | 0.0 | 0.0 | 0.0 | 10.0 | 0.0 | 0.0 | 0.0 | 10.0 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **426.8** | **-0.3** | **-0.3** | **-0.1** | **427.2** | **-0.6** | **-0.6** | **-0.6** | **424.2** | **1.2** | **1.2** | **1.2** |
| 10 | Pasture | 3.1 | 0.0 | 0.0 | 0.0 | 3.1 | 0.0 | 0.0 | 0.0 | 3.1 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 23.6 | 0.0 | 0.0 | -0.2 | 23.6 | -0.1 | 0.0 | -0.1 | 23.6 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 12.2 | 0.0 | 0.0 | 0.0 | 12.2 | 0.0 | 0.0 | 0.0 | 12.2 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 31.0 | 0.0 | 0.0 | -0.1 | 31.0 | 0.0 | 0.0 | 0.0 | 31.0 | 0.0 | 0.0 | 0.0 |
| | Rice | 2.3 | 0.0 | 0.0 | 0.0 | 2.3 | 0.0 | 0.0 | 0.0 | 2.3 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 718.0 | 0.0 | 0.0 | 0.0 | 717.9 | 0.1 | 0.0 | 0.1 | 718.1 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 60.1 | 0.0 | 0.0 | 0.0 | 60.1 | 0.0 | 0.0 | 0.0 | 60.1 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 52.4 | 0.0 | 0.0 | 0.0 | 52.4 | 0.0 | 0.0 | 0.0 | 52.4 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 7.6 | 0.0 | 0.0 | 0.0 | 7.5 | 0.1 | 0.0 | 0.1 | 7.6 | 0.0 | 0.0 | 0.0 |
| | Grapes | 1.9 | 0.0 | 0.0 | 0.0 | 1.9 | 0.0 | 0.0 | 0.0 | 1.9 | 0.0 | 0.0 | 0.0 |
| | Cotton | 102.6 | 0.0 | 0.0 | -0.5 | 102.7 | -0.1 | 0.0 | -0.1 | 102.6 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 0.4 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **1015.1** | **0.0** | **0.0** | **-0.8** | **1015.1** | **0.0** | **0.0** | **0.0** | **1015.2** | **0.0** | **0.0** | **0.0** |
| 11 | Pasture | 10.0 | 0.0 | 0.0 | 0.0 | 10.0 | 0.0 | 0.0 | 0.0 | 9.9 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 4.8 | 0.0 | 0.0 | 0.0 | 4.8 | 0.0 | 0.0 | 0.0 | 4.8 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 0.3 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 11.5 | 0.0 | 0.0 | 0.0 | 11.5 | 0.0 | 0.0 | 0.0 | 11.4 | 0.0 | 0.0 | 0.0 |
| | Rice | 3.5 | 0.0 | 0.0 | 0.0 | 3.6 | 0.0 | 0.0 | 0.0 | 3.5 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 40.1 | 0.0 | 0.0 | 0.0 | 40.1 | 0.0 | 0.0 | 0.0 | 40.0 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 1.2 | 0.0 | 0.0 | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 115.8 | 0.0 | 0.0 | 0.0 | 115.8 | 0.0 | 0.0 | 0.0 | 115.8 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 |
| | Grapes | 19.4 | 0.0 | 0.0 | 0.0 | 19.4 | 0.0 | 0.0 | 0.0 | 19.4 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **207.6** | **0.0** | **0.0** | **0.0** | **207.6** | **0.0** | **0.0** | **0.0** | **207.5** | **0.0** | **0.0** | **0.0** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | Pasture | 4.2 | 0.0 | 0.0 | 0.0 | 4.2 | 0.0 | 0.0 | 0.0 | 4.2 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 10.5 | 0.0 | 0.0 | 0.0 | 10.4 | 0.0 | 0.0 | 0.0 | 10.5 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 26.5 | 0.0 | 0.0 | 0.0 | 26.4 | 0.0 | 0.0 | 0.0 | 26.3 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 19.1 | 0.0 | 0.0 | 0.0 | 19.1 | 0.0 | 0.0 | 0.0 | 19.1 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 134.7 | 0.0 | 0.0 | 0.0 | 134.7 | 0.0 | 0.0 | 0.0 | 134.7 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 5.4 | 0.0 | 0.0 | 0.0 | 5.4 | 0.0 | 0.0 | 0.0 | 5.3 | 0.0 | 0.0 | 0.0 |
| | Grapes | 26.2 | 0.0 | 0.0 | 0.0 | 26.2 | 0.0 | 0.0 | 0.0 | 26.2 | 0.0 | 0.0 | 0.0 |
| | Cotton | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 3.5 | 0.0 | 0.0 | 0.0 | 3.5 | 0.0 | 0.0 | 0.0 | 3.5 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **231.2** | **0.0** | **0.0** | **0.0** | **230.9** | **0.0** | **0.0** | **0.0** | **230.8** | **0.0** | **0.0** | **0.0** |
| 13 | Pasture | 9.2 | 0.0 | 0.0 | 0.0 | 9.3 | -0.1 | -0.1 | -0.1 | 9.2 | -0.1 | -0.1 | -0.1 |
| | Alfalfa | 24.2 | 0.0 | 0.0 | 0.0 | 24.3 | -0.1 | -0.1 | -0.1 | 24.2 | -0.1 | -0.1 | -0.1 |
| | Sugar Beets | 4.4 | 0.0 | 0.0 | 0.0 | 4.4 | 0.0 | 0.0 | 0.0 | 4.4 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 35.2 | 0.0 | 0.0 | 0.0 | 35.4 | -0.1 | -0.1 | -0.1 | 35.1 | -0.1 | -0.1 | -0.1 |
| | Rice | 3.1 | 0.0 | 0.0 | 0.0 | 3.1 | 0.0 | 0.0 | 0.0 | 3.1 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 114.4 | 0.0 | 0.0 | 0.0 | 114.4 | 0.0 | 0.0 | 0.0 | 114.4 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 10.5 | 0.0 | 0.0 | 0.0 | 10.5 | 0.0 | 0.0 | 0.0 | 10.5 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 193.4 | 0.0 | 0.0 | 0.0 | 193.4 | 0.0 | 0.0 | 0.0 | 193.4 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 25.3 | 0.0 | 0.0 | 0.0 | 25.4 | 0.0 | 0.0 | -0.1 | 25.0 | 0.0 | 0.0 | 0.0 |
| | Grapes | 184.9 | 0.0 | 0.0 | 0.0 | 184.9 | 0.0 | 0.0 | 0.0 | 184.9 | 0.0 | 0.0 | 0.0 |
| | Cotton | 71.4 | 0.0 | 0.0 | -0.1 | 71.8 | -0.2 | -0.2 | -0.3 | 71.2 | -0.2 | -0.2 | -0.2 |
| | Subtropical Orchard | 34.7 | 0.0 | 0.0 | 0.0 | 34.7 | 0.0 | 0.0 | 0.0 | 34.7 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **710.6** | **0.0** | **0.0** | **0.0** | **711.5** | **-0.5** | **-0.5** | **-0.7** | **709.9** | **-0.6** | **-0.6** | **-0.6** |
| 14 | Pasture | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 8.6 | 0.0 | 0.0 | 0.0 | 8.6 | 0.0 | 0.0 | 0.0 | 8.2 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 3.9 | 0.0 | 0.0 | 0.0 | 4.0 | 0.0 | 0.0 | 0.0 | 3.9 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 11.0 | 0.0 | 0.0 | 0.0 | 10.9 | 0.0 | 0.0 | 0.0 | 10.7 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 817.9 | 0.0 | 0.0 | 0.0 | 817.8 | 0.0 | 0.0 | 0.0 | 816.9 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 114.6 | 0.0 | 0.0 | 0.1 | 114.6 | 0.0 | 0.0 | 0.0 | 113.3 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 38.5 | 0.0 | 0.0 | 0.0 | 38.5 | 0.0 | 0.0 | 0.0 | 38.5 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 5.2 | 0.0 | 0.0 | 0.0 | 5.2 | 0.0 | 0.0 | 0.0 | 4.9 | 0.0 | 0.0 | 0.0 |
| | Grapes | 15.1 | 0.0 | 0.0 | 0.0 | 15.1 | 0.0 | 0.0 | 0.0 | 15.1 | 0.0 | 0.0 | 0.0 |
| | Cotton | 234.6 | 0.0 | 0.0 | -0.1 | 234.7 | 0.0 | 0.0 | 0.0 | 225.8 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 3.7 | 0.0 | 0.0 | 0.0 | 3.7 | 0.0 | 0.0 | 0.0 | 3.7 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **1253.1** | **0.0** | **0.0** | **0.0** | **1253.1** | **0.0** | **0.0** | **0.0** | **1241.1** | **0.0** | **0.0** | **0.0** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | Pasture | 0.9 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 51.3 | 0.0 | 0.0 | 0.1 | 51.4 | 0.0 | 0.0 | 0.0 | 49.7 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 4.1 | 0.0 | 0.0 | 0.0 | 4.1 | 0.0 | 0.0 | 0.0 | 4.0 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 51.2 | 0.0 | 0.0 | 0.0 | 51.3 | 0.0 | 0.0 | 0.0 | 50.2 | 0.0 | 0.0 | 0.0 |
| | Rice | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 72.0 | 0.0 | 0.0 | 0.0 | 72.0 | 0.0 | 0.0 | 0.0 | 71.9 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 3.0 | 0.0 | 0.0 | 0.0 | 3.0 | 0.0 | 0.0 | 0.0 | 3.0 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 58.7 | 0.0 | 0.0 | 0.0 | 58.7 | 0.0 | 0.0 | 0.0 | 58.7 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 41.6 | 0.0 | 0.0 | 0.0 | 41.9 | 0.0 | 0.0 | 0.0 | 39.7 | 0.0 | 0.0 | 0.0 |
| | Grapes | 121.7 | 0.0 | 0.0 | 0.0 | 121.7 | 0.0 | 0.0 | 0.0 | 121.7 | 0.0 | 0.0 | 0.0 |
| | Cotton | 275.0 | 0.0 | 0.0 | -0.2 | 275.7 | 0.0 | 0.0 | -0.1 | 267.5 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 3.7 | 0.0 | 0.0 | 0.0 | 3.7 | 0.0 | 0.0 | 0.0 | 3.7 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **683.2** | **0.0** | **0.0** | **-0.1** | **684.5** | **0.0** | **0.0** | **0.0** | **671.1** | **0.0** | **0.0** | **0.0** |
| 16 | Pasture | 1.4 | 0.0 | 0.0 | 0.0 | 1.5 | 0.0 | 0.0 | 0.0 | 1.4 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 3.1 | 0.0 | 0.0 | 0.0 | 3.2 | 0.0 | 0.0 | 0.0 | 3.1 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 3.6 | 0.0 | 0.0 | 0.0 | 3.6 | 0.0 | 0.0 | 0.0 | 3.6 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 30.0 | 0.0 | 0.0 | 0.0 | 30.0 | 0.0 | 0.0 | 0.0 | 30.0 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 24.7 | 0.0 | 0.0 | 0.0 | 24.7 | 0.0 | 0.0 | 0.0 | 24.7 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 2.4 | 0.0 | 0.0 | 0.0 | 2.4 | 0.0 | 0.0 | 0.0 | 2.3 | 0.0 | 0.0 | 0.0 |
| | Grapes | 119.6 | 0.0 | 0.0 | 0.0 | 119.6 | 0.0 | 0.0 | 0.0 | 119.6 | 0.0 | 0.0 | 0.0 |
| | Cotton | 5.7 | 0.0 | 0.0 | 0.0 | 5.8 | -0.1 | -0.1 | -0.1 | 5.7 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 33.7 | 0.0 | 0.0 | 0.0 | 33.7 | 0.0 | 0.0 | 0.0 | 33.7 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **224.3** | **0.0** | **0.0** | **0.0** | **224.5** | **-0.2** | **-0.2** | **-0.2** | **224.2** | **0.0** | **0.0** | **0.0** |
| 17 | Pasture | 0.7 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 3.1 | 0.0 | 0.0 | 0.0 | 3.1 | 0.0 | 0.0 | 0.0 | 2.5 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 4.8 | 0.0 | 0.0 | 0.0 | 4.8 | 0.0 | 0.0 | 0.0 | 4.2 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 60.0 | 0.0 | 0.0 | 0.0 | 60.0 | 0.0 | 0.0 | 0.0 | 59.7 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 1.5 | 0.0 | 0.0 | 0.0 | 1.5 | 0.0 | 0.0 | 0.0 | 1.4 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 112.8 | 0.0 | 0.0 | 0.0 | 112.8 | 0.0 | 0.0 | 0.0 | 112.8 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 3.5 | 0.0 | 0.0 | 0.0 | 3.5 | 0.0 | 0.0 | 0.0 | 3.1 | 0.0 | 0.0 | 0.0 |
| | Grapes | 236.9 | 0.0 | 0.0 | 0.0 | 236.9 | 0.0 | 0.0 | 0.0 | 236.9 | 0.0 | 0.0 | 0.0 |
| | Cotton | 11.4 | 0.0 | 0.0 | 0.0 | 11.4 | 0.0 | 0.0 | 0.0 | 9.9 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 131.0 | 0.0 | 0.0 | 0.0 | 131.0 | 0.0 | 0.0 | 0.0 | 131.0 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **565.7** | **0.0** | **0.0** | **0.0** | **565.7** | **0.0** | **0.0** | **0.0** | **562.0** | **0.0** | **0.0** | **0.0** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | Pasture | 0.9 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 38.4 | 0.0 | 0.0 | 0.1 | 38.7 | -0.2 | -0.2 | -0.2 | 36.4 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 1.6 | 0.0 | 0.0 | 0.0 | 1.6 | 0.0 | 0.0 | 0.0 | 1.5 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 46.5 | 0.0 | 0.0 | 0.0 | 46.7 | -0.1 | -0.1 | -0.1 | 44.8 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 78.0 | 0.0 | 0.0 | 0.0 | 78.0 | 0.0 | 0.0 | 0.0 | 77.9 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 106.6 | 0.0 | 0.0 | 0.0 | 106.6 | 0.0 | 0.0 | 0.0 | 106.6 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 24.0 | 0.0 | 0.0 | 0.0 | 24.3 | -0.1 | -0.1 | -0.1 | 22.7 | 0.1 | 0.1 | 0.1 |
| | Grapes | 121.7 | 0.0 | 0.0 | 0.0 | 121.7 | 0.0 | 0.0 | 0.0 | 121.7 | 0.0 | 0.0 | 0.0 |
| | Cotton | 193.5 | 0.0 | 0.0 | -0.1 | 194.6 | -0.6 | -0.6 | -0.6 | 186.0 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 363.1 | 0.0 | 0.0 | 0.0 | 363.1 | 0.0 | 0.0 | 0.0 | 363.1 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **974.2** | **0.0** | **0.0** | **-0.1** | **976.1** | **-1.0** | **-1.0** | **-1.0** | **961.5** | **0.1** | **0.1** | **0.1** |
| 19 | Pasture | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 15.7 | 0.0 | 0.0 | 0.0 | 15.7 | 0.0 | 0.0 | 0.0 | 15.3 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 4.3 | 0.0 | 0.0 | 0.0 | 4.3 | 0.0 | 0.0 | 0.0 | 4.2 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 4.5 | 0.0 | 0.0 | 0.0 | 4.5 | 0.0 | 0.0 | 0.0 | 4.5 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 147.1 | 0.0 | 0.0 | 0.0 | 147.0 | 0.0 | 0.0 | 0.0 | 147.0 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 2.7 | 0.0 | 0.0 | 0.0 | 2.7 | 0.0 | 0.0 | 0.0 | 2.7 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 80.2 | 0.0 | 0.0 | 0.0 | 80.2 | 0.0 | 0.0 | 0.0 | 80.2 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 3.6 | 0.0 | 0.0 | 0.0 | 3.6 | 0.0 | 0.0 | 0.0 | 3.5 | 0.0 | 0.0 | 0.0 |
| | Grapes | 33.0 | 0.0 | 0.0 | 0.0 | 33.0 | 0.0 | 0.0 | 0.0 | 33.0 | 0.0 | 0.0 | 0.0 |
| | Cotton | 125.2 | 0.0 | 0.0 | -0.1 | 125.1 | 0.0 | 0.0 | 0.0 | 122.2 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 17.1 | 0.0 | 0.0 | 0.0 | 17.1 | 0.0 | 0.0 | 0.0 | 17.1 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **433.3** | **0.0** | **0.0** | **0.0** | **433.3** | **0.0** | **0.0** | **0.0** | **429.7** | **0.0** | **0.0** | **0.0** |
| 20 | Pasture | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 7.3 | 0.0 | 0.0 | 0.0 | 7.3 | 0.0 | 0.0 | 0.0 | 6.7 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 0.4 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 2.0 | 0.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 1.9 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 251.6 | 0.0 | 0.0 | 0.0 | 251.6 | 0.0 | 0.0 | 0.0 | 251.2 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 0.5 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 81.8 | 0.0 | 0.0 | 0.0 | 81.8 | 0.0 | 0.0 | 0.0 | 81.8 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 0.5 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 |
| | Grapes | 109.1 | 0.0 | 0.0 | 0.0 | 109.1 | 0.0 | 0.0 | 0.0 | 109.1 | 0.0 | 0.0 | 0.0 |
| | Cotton | 35.0 | 0.0 | 0.0 | 0.0 | 35.2 | 0.0 | 0.0 | 0.0 | 32.7 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 115.6 | 0.0 | 0.0 | 0.0 | 115.6 | 0.0 | 0.0 | 0.0 | 115.6 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **603.9** | **0.0** | **0.0** | **0.0** | **604.1** | **0.0** | **0.0** | **0.0** | **600.4** | **0.0** | **0.0** | **0.0** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | Pasture | 0.2 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 |
| | Alfalfa | 16.8 | 0.0 | 0.0 | 0.0 | 16.8 | 0.0 | 0.0 | 0.0 | 16.6 | 0.0 | 0.0 | 0.0 |
| | Sugar Beets | 6.4 | 0.0 | 0.0 | 0.0 | 6.4 | 0.0 | 0.0 | 0.0 | 6.3 | 0.0 | 0.0 | 0.0 |
| | Other Field Crops | 10.8 | 0.0 | 0.0 | 0.0 | 10.8 | 0.0 | 0.0 | 0.0 | 10.8 | 0.0 | 0.0 | 0.0 |
| | Rice | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Truck Crops | 661.4 | 0.0 | 0.0 | 0.0 | 661.3 | 0.0 | 0.0 | 0.1 | 661.3 | 0.0 | 0.0 | 0.0 |
| | Tomatoes | 1.6 | 0.0 | 0.0 | 0.0 | 1.6 | 0.0 | 0.0 | 0.0 | 1.6 | 0.0 | 0.0 | 0.0 |
| | Deciduous Orchard | 39.3 | 0.0 | 0.0 | 0.0 | 39.3 | 0.0 | 0.0 | 0.0 | 39.3 | 0.0 | 0.0 | 0.0 |
| | Small Grain | 0.9 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 |
| | Grapes | 122.1 | 0.0 | 0.0 | 0.0 | 122.1 | 0.0 | 0.0 | 0.0 | 122.1 | 0.0 | 0.0 | 0.0 |
| | Cotton | 128.3 | 0.0 | 0.0 | -0.1 | 128.3 | 0.0 | 0.0 | 0.0 | 126.7 | 0.0 | 0.0 | 0.0 |
| | Subtropical Orchard | 59.9 | 0.0 | 0.0 | 0.0 | 59.9 | 0.0 | 0.0 | 0.0 | 59.9 | 0.0 | 0.0 | 0.0 |
| | **Subtotal** | **1047.6** | **0.0** | **0.0** | **0.0** | **1047.6** | **0.0** | **0.0** | **0.0** | **1045.7** | **0.0** | **0.0** | **0.0** |

NOTES:
1. All values in millions of 1992 dollars.
2. A negative value represents a lower gross revenue in an alternative than in the Preferred Alternative.
3. Not all 12 crops are grown in all subregions.
4. Subregions 3 and 3B should be added together to get the complete subregion 3.  3B represents the area within this subregion served by the Tehama Colusa Canal.

**TABLE 19  CHANGES IN NET REVENUE BY SUBREGION (Million $)**

| CVPM Subregion | Cause of Net Revenue Change | | Change Compared to Average PA | | | | Change Compared to Wet PA | | | | hange Compared to Dry P | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Average | Wet | Dry | | Average | Wet | Dry | | Average | Wet | Dry |
| | | | Followed By Average | | | | Followed By Wet | | | | Followed By Dry | | |
| 1 | Fallowed Land | 1.8 | -0.1 | 0.0 | 0.0 | 1.8 | -0.1 | -0.1 | -0.1 | 1.7 | -0.1 | -0.1 | -0.1 |
| | Groundwater Pumping Cost | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -0.1 | 0.1 | 0.1 | 0.1 |
| | Irrigation Cost | 2.3 | -0.2 | -0.2 | -0.2 | -2.3 | -0.2 | -0.2 | -0.2 | -2.3 | -0.2 | -0.2 | -0.2 |
| | CVP Water Cost | 0.6 | 0.3 | 0.2 | 0.1 | -0.7 | 0.4 | 0.4 | 0.4 | -0.7 | 0.4 | 0.4 | 0.4 |
| | Higher Crop Prices | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **0.1** | **0.0** | **0.0** | **-1.2** | **0.2** | **0.2** | **0.2** | **-1.2** | **0.2** | **0.2** | **0.2** |
| 2 | Fallowed Land | 30.1 | 0.0 | 0.0 | -0.3 | 30.1 | 0.0 | 0.0 | -0.4 | 30.0 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 20.4 | 0.0 | 0.0 | 0.0 | -19.9 | 0.0 | 0.0 | 0.0 | -24.6 | 0.0 | 0.0 | 0.0 |
| | Irrigation Cost | 22.1 | 0.0 | 0.0 | 0.0 | -22.1 | 0.0 | 0.0 | 0.0 | -21.9 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 0.4 | -0.2 | 0.0 | 0.1 | -0.6 | -0.6 | -0.2 | 0.5 | -0.1 | 0.0 | 0.0 | -0.1 |
| | Higher Crop Prices | 0.1 | 0.0 | 0.0 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **-0.2** | **0.0** | **0.0** | **-12.4** | **-0.6** | **-0.2** | **0.1** | **-16.5** | **0.0** | **0.0** | **-0.1** |
| 3 | Fallowed Land | 39.3 | 0.0 | 0.0 | 0.0 | 39.4 | 0.0 | 0.0 | 0.0 | 38.9 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 9.0 | 0.0 | 0.0 | 0.0 | -7.9 | 0.0 | 0.0 | 0.0 | -14.5 | 0.0 | 0.0 | 0.0 |
| | Irrigation Cost | 21.2 | 0.0 | 0.0 | 0.0 | -21.3 | 0.0 | 0.0 | 0.0 | -21.0 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 1.6 | 0.0 | 0.0 | 0.0 | -1.6 | -0.2 | -0.2 | -0.2 | -1.4 | -0.3 | -0.3 | -0.3 |
| | Higher Crop Prices | 0.2 | 0.0 | 0.0 | 0.3 | 0.1 | 0.0 | 0.0 | 0.2 | 0.4 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **0.0** | **0.0** | **0.3** | **8.7** | **-0.2** | **-0.2** | **0.0** | **2.4** | **-0.3** | **-0.3** | **-0.3** |
| 3B | Fallowed Land | 11.9 | 0.0 | 0.0 | -6.4 | 11.9 | 0.0 | 0.0 | -3.8 | 10.6 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 3.0 | 0.0 | 0.0 | 0.0 | -1.8 | 1.4 | 1.4 | -4.1 | -8.3 | 0.0 | 0.0 | 0.0 |
| | Irrigation Cost | 9.0 | 0.0 | 0.0 | 0.0 | -9.1 | 0.0 | 0.0 | 0.0 | -7.7 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 3.7 | -0.4 | 1.4 | 3.7 | -4.2 | -4.7 | -1.2 | 4.2 | -0.9 | 0.2 | 0.2 | -0.3 |
| | Higher Crop Prices | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **-0.4** | **1.4** | **-2.8** | **-3.1** | **-3.3** | **0.2** | **-3.7** | **-6.3** | **0.2** | **0.2** | **-0.3** |
| 4 | Fallowed Land | 34.3 | 0.0 | 0.0 | 0.0 | 34.3 | 0.0 | 0.0 | 0.0 | 34.1 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 9.3 | 0.0 | 0.0 | 0.0 | -8.5 | 0.0 | 0.0 | 0.0 | -13.5 | 0.0 | 0.0 | 0.0 |
| | Irrigation Cost | 20.2 | 0.0 | 0.0 | 0.0 | -20.3 | 0.0 | 0.0 | 0.0 | -20.1 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 1.3 | 0.0 | 0.0 | 0.0 | -1.3 | -0.1 | -0.1 | -0.1 | -1.1 | -0.2 | -0.2 | -0.2 |
| | Higher Crop Prices | 0.2 | 0.0 | 0.0 | 0.3 | 0.1 | 0.0 | 0.0 | 0.1 | 0.3 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **0.0** | **0.0** | **0.3** | **4.4** | **-0.1** | **-0.1** | **0.0** | **-0.3** | **-0.2** | **-0.2** | **-0.2** |
| 5 | Fallowed Land | 53.4 | 0.0 | 0.0 | 0.0 | 53.5 | 0.0 | 0.0 | 0.0 | 53.2 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 14.9 | 0.0 | 0.0 | 0.0 | -13.0 | 0.0 | 0.0 | 0.0 | -18.7 | 0.0 | 0.0 | 0.0 |
| | Irrigation Cost | 22.5 | 0.0 | 0.0 | 0.0 | -22.6 | 0.0 | 0.0 | 0.0 | -22.4 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 0.2 | -0.3 | -0.3 | -0.3 | -0.2 | -0.3 | -0.3 | -0.3 | -0.2 | -0.3 | -0.3 | -0.3 |
| | Higher Crop Prices | 0.1 | 0.0 | 0.0 | 0.3 | 0.1 | 0.0 | 0.0 | 0.1 | 0.2 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **-0.3** | **-0.3** | **0.0** | **17.7** | **-0.3** | **-0.3** | **-0.2** | **12.1** | **-0.3** | **-0.3** | **-0.3** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | Fallowed Land | 32.3 | 0.0 | 0.0 | 0.0 | 32.5 | -0.2 | -0.2 | -0.2 | 32.2 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 14.9 | 0.0 | 0.0 | 0.0 | -14.4 | 0.3 | 0.3 | 0.3 | -17.6 | -0.1 | -0.1 | -0.1 |
| | Irrigation Cost | 21.6 | 0.0 | 0.0 | 0.0 | -21.8 | 0.0 | 0.0 | 0.0 | -21.5 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Higher Crop Prices | 0.3 | 0.0 | 0.0 | 0.4 | 0.2 | 0.0 | 0.0 | 0.2 | 0.5 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **0.0** | **0.0** | **0.4** | **-3.6** | **0.1** | **0.1** | **0.3** | **-6.4** | **-0.1** | **-0.1** | **-0.1** |
| 7 | Fallowed Land | 10.5 | 0.0 | 0.0 | 0.0 | 10.5 | 0.0 | 0.0 | 0.0 | 10.4 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 7.6 | 0.0 | 0.0 | 0.0 | -6.9 | 0.0 | 0.0 | 0.0 | -9.1 | 0.0 | 0.0 | 0.0 |
| | Irrigation Cost | 4.4 | 0.0 | 0.0 | 0.0 | -4.4 | 0.0 | 0.0 | 0.0 | -4.3 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 0.3 | -0.1 | -0.1 | -0.1 | -0.3 | -0.1 | -0.1 | -0.1 | -0.2 | -0.1 | -0.1 | -0.1 |
| | Higher Crop Prices | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **-0.1** | **-0.1** | **0.0** | **-1.0** | **-0.1** | **-0.1** | **0.0** | **-3.1** | **-0.1** | **-0.1** | **-0.1** |
| 8 | Fallowed Land | 46.4 | 0.0 | 0.0 | 0.0 | 46.5 | 0.0 | 0.0 | 0.0 | 46.4 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 30.8 | 0.0 | 0.0 | 0.0 | -29.1 | 0.1 | 0.1 | 0.1 | -35.4 | -0.1 | -0.1 | -0.1 |
| | Irrigation Cost | 21.1 | 0.0 | 0.0 | 0.0 | -21.1 | 0.0 | 0.0 | 0.0 | -21.0 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 0.3 | -0.8 | -0.5 | -1.6 | -0.5 | -2.0 | -1.2 | -2.8 | -0.1 | -0.3 | -0.3 | -0.4 |
| | Higher Crop Prices | 0.2 | 0.0 | 0.0 | 0.2 | 0.2 | 0.0 | 0.0 | 0.1 | 0.3 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **-0.8** | **-0.5** | **-1.3** | **-4.1** | **-1.9** | **-1.0** | **-2.5** | **-9.8** | **-0.3** | **-0.3** | **-0.5** |
| 9 | Fallowed Land | 52.9 | -0.1 | -0.1 | 0.0 | 52.9 | -0.1 | -0.1 | -0.1 | 52.4 | 0.2 | 0.2 | 0.2 |
| | Groundwater Pumping Cost | 2.5 | -0.6 | -0.6 | -0.6 | -2.1 | -1.2 | -1.2 | -1.2 | -3.2 | -0.4 | -0.4 | -0.4 |
| | Irrigation Cost | 34.4 | -0.3 | -0.3 | -0.3 | -34.4 | -0.3 | -0.3 | -0.3 | -33.9 | -0.3 | -0.3 | -0.3 |
| | CVP Water Cost | 1.2 | 1.2 | 1.2 | 1.2 | -2.0 | 2.0 | 2.0 | 2.0 | -0.5 | 0.5 | 0.5 | 0.5 |
| | Higher Crop Prices | 0.3 | 0.0 | 0.0 | 0.5 | 0.3 | 0.0 | 0.0 | 0.2 | 0.6 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **0.3** | **0.3** | **0.7** | **14.5** | **0.5** | **0.5** | **0.7** | **15.5** | **0.0** | **0.0** | **0.0** |
| 10 | Fallowed Land | 97.8 | 0.0 | 0.0 | -0.1 | 97.8 | 0.0 | 0.0 | 0.0 | 97.8 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 15.4 | 0.0 | 0.0 | -6.8 | -12.5 | -8.3 | -0.8 | -8.6 | -20.6 | 0.0 | 0.0 | 0.0 |
| | Irrigation Cost | 38.9 | 0.0 | 0.0 | 0.0 | -38.9 | 0.0 | 0.0 | 0.0 | -38.9 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 6.3 | -0.1 | 0.4 | 6.3 | -8.1 | 7.9 | 0.7 | 8.1 | -3.2 | 0.2 | 0.2 | -0.1 |
| | Higher Crop Prices | 0.5 | 0.0 | 0.0 | 0.4 | 0.4 | 0.0 | 0.0 | 0.2 | 0.9 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **-0.1** | **0.4** | **-0.1** | **38.7** | **-0.5** | **0.0** | **-0.3** | **36.0** | **0.2** | **0.2** | **-0.1** |
| 11 | Fallowed Land | 35.5 | 0.0 | 0.0 | 0.0 | 35.5 | 0.0 | 0.0 | 0.0 | 35.4 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 1.0 | 0.0 | 0.0 | 0.0 | -0.8 | 0.0 | 0.0 | 0.0 | -1.1 | 0.0 | 0.0 | 0.0 |
| | Irrigation Cost | 16.0 | 0.0 | 0.0 | 0.0 | -16.0 | 0.0 | 0.0 | 0.0 | -16.0 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Higher Crop Prices | 0.1 | 0.0 | 0.0 | 0.3 | 0.1 | 0.0 | 0.0 | 0.1 | 0.2 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **0.0** | **0.0** | **0.3** | **18.7** | **0.0** | **0.0** | **0.1** | **18.6** | **0.0** | **0.0** | **0.0** |
| 12 | Fallowed Land | 41.8 | 0.0 | 0.0 | 0.0 | 41.7 | 0.0 | 0.0 | 0.0 | 41.7 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 6.1 | 0.0 | 0.0 | 0.0 | -4.8 | 0.0 | 0.0 | 0.0 | -8.4 | 0.0 | 0.0 | 0.0 |
| | Irrigation Cost | 19.9 | 0.0 | 0.0 | 0.0 | -19.8 | 0.0 | 0.0 | 0.0 | -19.8 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Higher Crop Prices | 0.1 | 0.0 | 0.0 | 0.3 | 0.1 | 0.0 | 0.0 | 0.1 | 0.2 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **0.0** | **0.0** | **0.3** | **17.2** | **0.0** | **0.0** | **0.1** | **13.7** | **0.0** | **0.0** | **0.0** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | Fallowed Land | 112.2 | 0.0 | 0.0 | 0.0 | 112.3 | -0.1 | -0.1 | -0.1 | 112.1 | -0.1 | -0.1 | -0.1 |
| | Groundwater Pumping Cost | 38.4 | 0.8 | 0.7 | -2.7 | -33.9 | 1.6 | 1.6 | -4.9 | -50.7 | 0.2 | 0.2 | 0.2 |
| | Irrigation Cost | 53.6 | 0.0 | 0.0 | 0.0 | -53.8 | 0.0 | 0.0 | 0.0 | -53.6 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 6.8 | -0.8 | -0.6 | 2.1 | -6.4 | -1.7 | -1.5 | 4.3 | -5.4 | -0.2 | -0.2 | -0.4 |
| | Higher Crop Prices | 0.4 | 0.0 | 0.0 | 0.5 | 0.4 | 0.0 | 0.0 | 0.2 | 0.8 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **0.0** | **0.1** | **-0.1** | **18.7** | **-0.1** | **0.0** | **-0.5** | **3.3** | **-0.1** | **-0.1** | **-0.3** |
| 14 | Fallowed Land | 111.5 | 0.0 | 0.0 | 0.0 | 111.5 | 0.0 | 0.0 | 0.0 | 110.3 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 81.1 | 0.0 | 0.0 | 0.0 | -58.3 | 0.0 | 0.0 | 0.0 | -118.6 | 0.0 | 0.0 | 0.0 |
| | Irrigation Cost | 62.8 | 0.0 | 0.0 | 0.0 | -62.8 | 0.0 | 0.0 | 0.0 | -61.1 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 32.8 | 1.3 | 3.5 | -6.0 | -45.1 | 1.8 | 6.4 | -5.5 | -14.4 | -6.3 | -6.3 | -7.3 |
| | Higher Crop Prices | 0.7 | 0.0 | 0.0 | 0.5 | 0.6 | 0.0 | 0.0 | 0.2 | 1.2 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **1.3** | **3.5** | **-5.6** | **-53.9** | **1.8** | **6.4** | **-5.3** | **-82.6** | **-6.3** | **-6.3** | **-7.3** |
| 15 | Fallowed Land | 94.1 | 0.0 | 0.0 | 0.0 | 94.2 | 0.0 | 0.0 | 0.0 | 92.6 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 81.0 | 0.0 | 0.0 | 0.0 | -69.3 | 0.3 | 0.3 | 0.3 | -102.9 | -1.5 | -1.5 | -1.5 |
| | Irrigation Cost | 61.8 | 0.0 | 0.0 | 0.0 | -61.9 | 0.0 | 0.0 | 0.0 | -60.3 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 1.8 | -0.3 | -0.2 | -0.4 | -1.9 | -0.2 | -0.2 | -0.3 | -1.5 | -0.4 | -0.4 | -0.5 |
| | Higher Crop Prices | 0.7 | 0.0 | 0.0 | 0.4 | 0.6 | 0.1 | 0.0 | 0.2 | 1.5 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **-0.3** | **-0.2** | **0.1** | **-38.3** | **0.2** | **0.2** | **0.2** | **-70.7** | **-1.9** | **-1.9** | **-1.9** |
| 16 | Fallowed Land | 37.3 | 0.0 | 0.0 | 0.0 | 37.3 | 0.0 | 0.0 | 0.0 | 37.3 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 1.9 | -0.6 | -0.6 | -0.6 | 0.0 | -0.5 | -0.5 | -0.5 | -4.3 | -0.5 | -0.5 | -0.5 |
| | Irrigation Cost | 11.0 | 0.0 | 0.0 | 0.0 | -11.1 | 0.0 | 0.0 | 0.0 | -11.0 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 0.7 | 0.7 | 0.7 | 0.7 | -0.7 | 0.7 | 0.7 | 0.7 | -0.5 | 0.5 | 0.5 | 0.5 |
| | Higher Crop Prices | 0.1 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **0.0** | **0.0** | **0.1** | **25.7** | **0.1** | **0.1** | **0.1** | **21.6** | **0.0** | **0.0** | **0.0** |
| 17 | Fallowed Land | 95.8 | 0.0 | 0.0 | 0.0 | 95.8 | 0.0 | 0.0 | 0.0 | 95.2 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 17.7 | 0.2 | 0.2 | 0.2 | -12.7 | 0.3 | 0.3 | 0.3 | -25.5 | 0.0 | 0.0 | 0.0 |
| | Irrigation Cost | 27.8 | 0.0 | 0.0 | 0.0 | -27.8 | 0.0 | 0.0 | 0.0 | -27.4 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 1.4 | -0.1 | -0.1 | -0.3 | -1.2 | -0.4 | -0.3 | -0.5 | -1.1 | 0.0 | 0.0 | -0.1 |
| | Higher Crop Prices | 0.2 | 0.0 | 0.0 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **0.0** | **0.1** | **0.1** | **54.2** | **0.0** | **0.0** | **-0.1** | **41.5** | **0.0** | **0.0** | **-0.1** |
| 18 | Fallowed Land | 153.6 | 0.0 | 0.0 | 0.0 | 153.9 | -0.1 | -0.1 | -0.1 | 151.9 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 57.9 | 0.0 | 0.0 | 0.0 | -46.2 | 0.2 | 0.2 | 0.2 | -78.0 | 0.0 | 0.0 | 0.0 |
| | Irrigation Cost | 64.9 | 0.0 | 0.0 | 0.0 | -65.1 | 0.0 | 0.0 | 0.0 | -63.2 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 17.7 | -1.5 | -1.0 | -3.3 | -17.7 | -2.2 | -1.7 | -3.9 | -15.2 | 0.8 | 0.8 | 0.0 |
| | Higher Crop Prices | 0.6 | 0.0 | 0.0 | 0.4 | 0.5 | 0.0 | 0.0 | 0.1 | 1.1 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **-1.5** | **-1.0** | **-2.9** | **25.3** | **-2.1** | **-1.6** | **-3.7** | **-3.4** | **0.8** | **0.8** | **0.0** |
| 19 | Fallowed Land | 54.3 | 0.0 | 0.0 | 0.0 | 54.3 | 0.0 | 0.0 | 0.0 | 53.9 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 31.6 | 0.0 | 0.0 | 0.0 | -21.3 | 0.2 | 0.2 | 0.2 | -51.5 | -1.2 | -1.2 | -1.2 |
| | Irrigation Cost | 28.8 | 0.0 | 0.0 | 0.0 | -28.8 | 0.0 | 0.0 | 0.0 | -28.3 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 0.5 | -0.5 | -0.5 | -0.6 | -0.6 | -0.5 | -0.5 | -0.5 | -0.4 | -0.5 | -0.5 | -0.5 |
| | Higher Crop Prices | 0.3 | 0.0 | 0.0 | 0.2 | 0.3 | 0.0 | 0.0 | 0.1 | 0.6 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **-0.5** | **-0.5** | **-0.3** | **3.9** | **-0.3** | **-0.3** | **-0.3** | **-25.7** | **-1.8** | **-1.8** | **-1.8** |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | Fallowed Land | 81.5 | 0.0 | 0.0 | 0.0 | 81.5 | 0.0 | 0.0 | 0.0 | 81.0 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 24.7 | 0.0 | 0.0 | 0.0 | -19.7 | 0.0 | 0.0 | 0.0 | -36.6 | -0.2 | -0.2 | -0.2 |
| | Irrigation Cost | 20.9 | 0.0 | 0.0 | 0.0 | -20.9 | 0.0 | 0.0 | 0.0 | -20.5 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 9.2 | -0.1 | 0.2 | -0.9 | -9.5 | -0.3 | -0.1 | -1.1 | -7.0 | -0.2 | -0.2 | -0.5 |
| | Higher Crop Prices | 0.2 | 0.0 | 0.0 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **-0.1** | **0.2** | **-0.8** | **31.5** | **-0.3** | **0.0** | **-1.1** | **17.2** | **-0.3** | **-0.3** | **-0.7** |
| 21 | Fallowed Land | 112.4 | 0.0 | 0.0 | 0.0 | 112.4 | 0.0 | 0.0 | 0.0 | 112.1 | 0.0 | 0.0 | 0.0 |
| | Groundwater Pumping Cost | 49.3 | 0.0 | 0.0 | 0.0 | -37.6 | 0.2 | 0.2 | 0.2 | -68.4 | -0.8 | -0.8 | -0.8 |
| | Irrigation Cost | 37.1 | 0.0 | 0.0 | 0.0 | -37.1 | 0.0 | 0.0 | 0.0 | -36.8 | 0.0 | 0.0 | 0.0 |
| | CVP Water Cost | 8.4 | 0.1 | 0.3 | -0.5 | -9.6 | 0.2 | 0.5 | -0.4 | -5.5 | -0.7 | -0.7 | -0.9 |
| | Higher Crop Prices | 0.4 | 0.0 | 0.0 | 0.2 | 0.4 | 0.0 | 0.0 | 0.1 | 0.7 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **0.1** | **0.3** | **-0.3** | **28.5** | **0.4** | **0.7** | **-0.1** | **2.1** | **-1.5** | **-1.5** | **-1.7** |
| Total | Fallowed Land | | -0.1 | 0.0 | -6.8 | 1100.4 | -0.4 | -0.3 | -4.6 | 1093.0 | -0.2 | -0.2 | -0.2 |
| | Groundwater Pumping | | 0.4 | 0.4 | -9.9 | -364.0 | -4.4 | 3.1 | -16.6 | -616.9 | -4.0 | -4.0 | -4.0 |
| | Irrigation Cost | | -0.3 | -0.3 | -0.3 | -503.5 | -0.3 | -0.3 | -0.3 | -496.0 | -0.3 | -0.3 | -0.3 |
| | CVP Water Cost | | -1.3 | 4.3 | 2.3 | -91.1 | 0.0 | 2.9 | 6.5 | -42.5 | -8.0 | -7.9 | -10.7 |
| | Higher Crop Prices | | 0.1 | 0.0 | 4.7 | 4.1 | 0.4 | 0.4 | 1.9 | 8.6 | 0.0 | 0.0 | 0.0 |
| | **Net Change** | | **-1.1** | **4.4** | **-10.0** | **146.0** | **-4.6** | **5.8** | **-13.2** | **-53.9** | **-12.4** | **-12.4** | **-15.1** |

Notes:

1. All values in millions of 1992 dollars
2. A negative value represents a reduction in net revenue compared to the Preferred Alternative
3. Subregions 3 and 3B should be added together to get the complete subregion 3. 3B represents the area within this subregion served by the Tehama Colusa Canal
4. PA is the Preferred Alternative

## TABLE 20 IRRIGATION WATER APPLIED BY SUBREGION

| CVPM Subregion | Water Source | Preferred Alternative Average | Changes Compared to Average PA | | | Preferred Alternative Wet | Changes Compared to Wet PA | | | Preferred Alternative Dry | Changes Compared to Dry PA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Average | Wet | Dry | | Average | Wet | Dry | | Average | Wet | Dry |
| | | | Followed by Average | | | | Followed by Wet | | | | Followed by Dry | | |
| 1 | CVP Water | 19.3 | -10.8 | -6.4 | -5.4 | 20.5 | -13.0 | -13.0 | -13.0 | 21.0 | -13.5 | -13.5 | -13.5 |
| | Groundwater | 3.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.5 | -1.5 | -1.5 | -1.5 |
| 2 | CVP Water | 27.7 | 0.0 | 0.0 | -21.6 | 37.1 | 0.0 | 0.1 | -36.7 | 8.2 | 0.0 | 0.0 | 0.0 |
| | Groundwater | 512.1 | 0.0 | 0.0 | 0.0 | 506.4 | 0.0 | -0.1 | 0.0 | 584.7 | 0.0 | 0.0 | 0.0 |
| 3 | CVP Water | 170.4 | 0.0 | 0.0 | 0.0 | 174.2 | 0.0 | 0.0 | 0.0 | 154.3 | 0.0 | 0.0 | 0.0 |
| | Groundwater | 248.9 | 0.0 | 0.0 | 0.0 | 227.0 | 0.0 | 0.0 | 0.0 | 355.3 | 0.0 | 0.0 | 0.0 |
| 3B | CVP Water | 199.6 | 0.1 | 0.0 | -199.6 | 227.0 | 39.3 | 39.1 | -227.0 | 50.3 | 0.0 | 0.0 | -0.1 |
| | Groundwater | 78.7 | -0.1 | 0.0 | 0.0 | 50.4 | -38.4 | -38.2 | 99.6 | 191.9 | 0.0 | 0.0 | 0.0 |
| 4 | CVP Water | 129.8 | 0.0 | 0.0 | 0.0 | 133.1 | 0.0 | 0.0 | 0.0 | 113.9 | 0.0 | 0.0 | 0.0 |
| | Groundwater | 326.6 | 0.0 | 0.0 | 0.0 | 305.1 | 0.0 | 0.0 | 0.0 | 442.8 | 0.0 | 0.0 | 0.0 |
| 5 | CVP Water | 19.9 | 0.1 | 0.0 | 0.1 | 20.8 | 0.1 | 0.0 | 0.0 | 17.9 | 0.0 | -0.1 | 0.0 |
| | Groundwater | 492.6 | -0.1 | 0.0 | -0.1 | 449.3 | -1.1 | -1.0 | -0.4 | 588.7 | -1.1 | -1.0 | -1.1 |
| 6 | CVP Water | 2.2 | 0.0 | 0.0 | 0.0 | 2.4 | 0.0 | 0.0 | 0.0 | 1.8 | 0.0 | 0.0 | 0.0 |
| | Groundwater | 452.8 | 0.0 | 0.0 | 0.0 | 447.6 | -6.4 | -6.4 | -6.0 | 521.0 | 0.0 | 0.0 | 0.0 |
| 7 | CVP Water | 22.0 | 0.0 | 0.0 | 0.0 | 22.6 | 0.0 | 0.0 | 0.0 | 19.1 | 0.0 | 0.0 | 0.0 |
| | Groundwater | 193.2 | 0.0 | 0.0 | 0.0 | 177.9 | 0.0 | 0.0 | 0.0 | 217.5 | 0.0 | 0.0 | 0.0 |
| 8 | CVP Water | 51.6 | 0.1 | 0.0 | -0.1 | 79.4 | 0.1 | -0.1 | -0.1 | 25.3 | 0.0 | 0.0 | -0.1 |
| | Groundwater | 756.4 | -0.1 | 0.0 | 0.1 | 717.3 | 0.0 | 0.0 | 0.0 | 851.3 | -0.2 | -0.2 | -0.1 |
| 9 | CVP Water | 28.2 | -28.2 | -28.2 | -28.2 | 48.1 | -48.1 | -48.1 | -48.1 | 11.5 | -11.5 | -11.5 | -11.5 |
| | Groundwater | 80.3 | 17.9 | 17.9 | 18.7 | 70.2 | 35.6 | 35.6 | 36.0 | 100.1 | 11.5 | 11.5 | 11.4 |
| 10 | CVP Water | 183.4 | 0.0 | 0.0 | -183.4 | 234.4 | -228.4 | -22.8 | -234.4 | 92.1 | 0.0 | 0.0 | 0.0 |
| | Groundwater | 496.2 | 0.0 | 0.0 | 179.4 | 414.4 | 227.7 | 22.7 | 233.7 | 632.4 | 0.0 | 0.0 | -0.1 |
| 11 | CVP Water | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Groundwater | 34.1 | 0.0 | 0.0 | 0.0 | 26.8 | 0.0 | 0.0 | 0.0 | 34.5 | 0.0 | 0.0 | 0.0 |
| 12 | CVP Water | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Groundwater | 173.1 | 0.0 | 0.0 | 0.0 | 141.8 | 0.0 | 0.0 | 0.0 | 228.2 | 0.0 | 0.0 | 0.0 |
| 13 | CVP Water | 163.6 | 16.7 | 16.6 | -60.2 | 159.0 | 33.2 | 33.1 | -113.1 | 128.2 | 0.0 | 0.0 | 0.0 |
| | Groundwater | 912.5 | -16.7 | -16.6 | 60.2 | 812.0 | -36.2 | -36.2 | 109.1 | 1,181.4 | -3.8 | -3.8 | -3.8 |
| 14 | CVP Water | 524.4 | 0.1 | 0.0 | 0.1 | 719.0 | 0.1 | 0.0 | 0.0 | 230.2 | 0.0 | 0.0 | 0.0 |
| | Groundwater | 826.3 | -0.1 | 0.0 | -0.1 | 603.6 | -0.1 | 0.0 | 0.0 | 1,176.4 | 0.0 | 0.0 | 0.0 |
| 15 | CVP Water | 35.1 | 0.0 | 0.1 | 0.1 | 38.1 | 0.0 | 0.1 | 0.0 | 28.6 | 0.0 | 0.0 | 0.0 |
| | Groundwater | 1,276.6 | 0.0 | -0.1 | -0.1 | 1,099.1 | 0.0 | 0.0 | 0.0 | 1,600.7 | 0.0 | 0.0 | 0.0 |
| 16 | CVP Water | 16.2 | -16.2 | -16.2 | -16.2 | 15.7 | -15.7 | -15.7 | -15.7 | 12.9 | -12.9 | -12.9 | -12.9 |
| | Groundwater | 49.6 | 14.9 | 14.8 | 15.0 | 0.0 | 13.2 | 13.2 | 13.2 | 107.3 | 11.5 | 11.5 | 11.5 |
| 17 | CVP Water | 34.6 | 3.9 | 3.8 | 4.0 | 32.5 | 7.4 | 7.3 | 7.4 | 27.1 | 0.0 | 0.0 | 0.1 |
| | Groundwater | 415.1 | -3.8 | -3.8 | -3.9 | 303.2 | -7.4 | -7.2 | -7.4 | 577.4 | 0.0 | 0.0 | 0.0 |
| 18 | CVP Water | 517.3 | 0.0 | 0.0 | 0.1 | 526.3 | 0.0 | 0.0 | 0.1 | 399.0 | 0.0 | 0.0 | 0.1 |
| | Groundwater | 1,018.0 | 0.0 | 0.0 | -0.1 | 821.8 | -4.0 | -4.0 | -3.8 | 1,334.9 | 0.0 | 0.0 | 0.0 |
| 19 | CVP Water | 13.3 | -0.1 | 0.0 | 0.1 | 15.4 | -0.1 | -0.1 | 0.0 | 9.4 | 0.0 | 0.0 | 0.0 |
| | Groundwater | 366.8 | 0.1 | 0.0 | -0.1 | 250.7 | 0.0 | 0.0 | 0.0 | 578.4 | 0.0 | 0.0 | 0.0 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | CVP Water | 208.7 | 0.1 | 0.1 | -0.2 | 219.8 | 0.1 | 0.1 | -0.1 | 154.1 | 0.0 | 0.0 | -0.1 |
| | Groundwater | 303.6 | -0.1 | -0.1 | 0.1 | 244.8 | 0.0 | 0.0 | 0.0 | 437.3 | 0.0 | 0.0 | 0.0 |
| 21 | CVP Water | 138.3 | 0.0 | 0.0 | -0.1 | 163.0 | 0.0 | 0.1 | -0.1 | 89.3 | 0.0 | 0.0 | -0.1 |
| | Groundwater | 579.4 | 0.0 | 0.0 | 0.1 | 445.2 | 0.0 | -0.1 | 0.0 | 783.1 | 0.0 | 0.0 | 0.0 |
| Total | CVP Water | 2,505.5 | -34.4 | -30.4 | -510.5 | 2,888.2 | -224.9 | -19.8 | -680.6 | 1,593.9 | -37.7 | -37.8 | -37.8 |
| | Groundwater | 9,596.5 | 11.9 | 12.3 | 269.2 | 8,114.6 | 182.8 | -21.6 | 474.0 | 12,527.1 | 16.1 | 16.2 | 16.1 |

Notes:

1. All quantities in thousands of acre-feet
2. A negative value represents a lower quantitity than in the Preferred Alternative
3. Subregions 3 and 3B should be added together to get the complete subregion 3. 3B represents the area within this subregion served by the Tehama Colusa Canal
4. PA is the Preferred Alternative

## TABLE 21 SUBREGION ANALYSIS OF SIGNIFICANT CHANGES IN WATER USE

| Subregion | Outcome | Explanation |
|---|---|---|
| 1 | Decrease in CVP use and no GW substitution in all sequences | Less CVP water is used than in the Preferred Alternative because the blended price is 140% to 330% higher than the Preferred Alternative Tier 1 ( the only tier of water that was used for this scenario). For hydrologic reasons, subregion 1 is restricted from switching to groundwater. |
| 2 | Decrease in CVP use and no GW substitution in Dry to Average and Dry to Wet sequences | Less CVP water is used than in the Preferred Alternative because the blended prices for the Dry to Average and Dry to Wet sequences are 320% and 345% higher than the Preferred Alternative Tier 1 price (the only water tier that was used for this scenario). For hydrologic reasons, subregion 2 is restricted from switching to groundwater. |
| 3B | Decrease CVP and no GW substitution in Dry to Average sequence | Less CVP water is used than in the Preferred Alternative because the blended price is 240% higher than the Tier 1 price from the Preferred Alternative, which is the only tier of water that was used. For hydrologic reasons the region is restricted from switching to groundwater in this long-run scenario. |
| 3B | Decrease in CVP use and GW substitution in Dry to Wet sequence | CVP water use decreases because the blended price is 260% higher than the Preferred Alternative Tier 1 price. The model allowed a shift to groundwater on a short run basis to provide water to permanent crops during the wet year when groundwater would have been recharged. |
| 3B | Shift from Groundwater to CVP water in Average to Wet and Wet to Wet sequences | In the Preferred Alternative wet year analysis subregion 3B has 39 TAF of water that falls in Tiers 2 or 3. Under the LTCR blended pricing mechanism all of the subregions CVP water is prices at a level that is lower than the Preferred Alternative Tier 2. This additional affordable CVP water is used resulting in a less groundwater being pumped. |
| 9 | Shift from CVP to Groundwater in all sequences | The blended price of CVP water in subregion 9 is greater than the groundwater pumping cost resulting in the shift from CVP to groundwater. |
| 10 | Shift from CVP to Groundwater in Dry to Average and Average, Wet and Dry to Wet sequences | Due to an increase in the CVP price relative to the Preferred Alternative, the depth to which groundwater can be affordable pumped increases resulting in the shift from CVP supplies to groundwater. |
| 13 | Shift from groundwater to CVP in Average to Average, Wet to Average, Average to Wet and Wet to Wet sequences | In the Preferred Alternative Average and Wet conditions subregion 13 had water classified as Tier 2 or Tier 3 which was not affordable, and pumped groundwater to supplement it's Tier 1 supply down to a depth at which it was no longer affordable. In the LTCR sequences, the blended price is less expensive than the Preferred Alternative upper Tier price, therefor a shift is made from the deepest groundwater to the now affordable CVP supply. |
| 13 | Shift from CVP to Groundwater in Dry to Average and Dry to Wet sequences | Under the LTCR blended price mechanism, when coming out of a drought into a Average or Wet year the blended price increases. In these situations, shallow groundwater is less expensive than the CVP blended price. As more groundwater is pumped the cost increases as the pump lift increases and the cost eventually becomes greater than the CVP blended price. When this happens the remainder of the subregions water supply is taken from the CVP supplies. |

| | | |
|---|---|---|
| 16 | Shift from CVP to Groundwater in all sequences | The blended price of CVP water in subregion 16 is greater than the groundwater pumping cost resulting in the shift from CVP to groundwater. |
| 17 | Shift from groundwater to CVP | In the Preferred Alternative Average and Wet conditions this subregion had water classified as Tier 2 or Tier 3 which was not affordable. The subregion pumped groundwater down to a depth at which it was no longer affordable to supplement the CVP water is was able to afford. In the LTCR sequences, the blended price is less expensive than the least expensive CVP tier that was not used, therefor a shift is made from the deepest groundwater to the now affordable CVP supply. |
| 19 | Shift from CVP to Groundwater in Dry to Dry sequence | The blended pricing causes the Dry to Dry CVP water cost to rise higher than the groundwater pumping cost resulting in the shift from CVP to groundwater. |

# SECTION 2
# REGIONAL ECONOMICS

# REGIONAL ECONOMICS

This analysis identifies the regional economic impacts of two out of the nine total Long Term Contract Renewal sequences; an Average year following an Average 5-year base condition, and a Average year following a Dry 5-year base condition. The regional economic analysis is restricted to these sequences because they are the only sequences that represent long-run conditions. The Input-Output model used in the regional economic analysis assumes a long run equilibrium is reached, therefore it is inappropriate to model short run responses represented by the Wet and Dry year conditions. While the Average year following the Dry 5-year base condition is not strictly a long-run scenario, as described in the Agricultural and Land Use and Economics section, there are some regions that will be permanently impacted by a five year series of drought years. Because of this, the results can be considered long run.

The assumptions and baseline data used in this analysis are the same as what was used in the Preferred Alternative. Tables 23 and 24 show the results of the Average year following an Average 5-year base condition, Tables 25 and 26 the Average year following an Wet 5-year base condition, and Tables 27 and 28 the Average year following an Dry 5-year base condition. Tables 23, 25, and 27 present the impacts by economic sectors that are aggregations of SIC industries. Tables 24, 26, and 28 present the regional economic impacts broken out by the source of the impact including reduced agricultural output, changes in net farm income, and changes in M&I water costs. Note that regional economic impacts are not reported for the North Coast or the Central and South Coast regions because the rolling five year average tiered pricing mechanism has no impact on these regions.

## AVERAGE YEAR FOLLOWING AVERAGE 5-YEAR BASE CONDITION

Table 23 shows the employment, output and income effects on all sectors in each regional economy of the long-term contract renewals. Most of the impacts are felt in the Manufacturing, Trade and Services sectors. These impacts are derived from the impact to net income. The economic impacts by region from each source can be seen in Table 24. Reduction in net income resulting from changes in CVP water cost, groundwater pumping, irrigation costs and changes in crop prices have the greatest impact at the statewide level.

## AVERAGE YEAR FOLLOWING DRY 5-YEAR BASE CONDITION

Table 27 shows the employment, output and income effects for each regional economy and the State as a whole broken out by the impacted sectors. Table 28 shows how each of the impact sources contribute to the total impact. The reduction in agricultural output in the Sacramento River region relative to the Preferred Alternative dominates the Statewide impact.

## TABLE 22

### REGIONAL ECONOMIC IMPACTS ON ALL SECTORS: AVERAGE YEAR FOLLOWING AVERAGE 5-YEAR BASE CONDITION COMPARED TO THE PREFERRED ALTERNATIVE AVERAGE YEAR CONDITION

| | Impacts on all Sectors | | | | | |
|---|---|---|---|---|---|---|
| | Employment (# of jobs) | | Output ($MM) | | PoW Income ($MM) | |
| **Region Directly Impacted** | **Direct** | **Total** | **Direct** | **Total** | **Direct** | **Total** |
| **Sacramento River** | | | | | | |
| Agriculture | | | | | | |
| Reduced Output | -10 | -20 | -0.5 | -1.2 | -0.2 | -0.6 |
| Reduced Net Income | -20 | -50 | -0.9 | -2.3 | -0.5 | -1.3 |
| Total Agriculture | -30 | -60 | -1.4 | -3.5 | -0.7 | -1.9 |
| M&I Water Costs | -60 | -130 | -3.9 | -8.5 | -2.0 | -4.7 |
| **TOTAL 1/** | **-90** | **-190** | -5.3 | -12.0 | -2.8 | -6.6 |
| **San Joaquin River** | | | | | | |
| Agriculture | | | | | | |
| Reduced Output | 0 | 0 | -0.2 | -0.3 | -0.1 | -0.2 |
| Reduced Net Income | 20 | 40 | 0.8 | 1.8 | 0.5 | 1.0 |
| Total Agriculture | 20 | 30 | 0.7 | 1.5 | 0.4 | 0.9 |
| M&I Water Costs | -80 | -150 | -5.0 | -9.4 | -2.6 | -5.1 |
| **TOTAL 1/** | **-60** | **-120** | -4.3 | -7.9 | -2.2 | -4.2 |
| **Tulare Lake** | | | | | | |
| Agriculture | | | | | | |
| Reduced Output | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Reduced Net Income | -50 | -80 | -2.1 | -4.1 | -1.1 | -2.2 |
| Total Agriculture | -50 | -80 | -2.1 | -4.1 | -1.1 | -2.2 |
| M&I Water Costs | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **TOTAL 1/** | **-50** | **-80** | -2.1 | -4.1 | -1.1 | -2.2 |
| **Bay Area** | | | | | | |
| Agriculture | | | | | | |
| Reduced Output | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Reduced Net Income | 0 | -10 | -0.2 | -0.4 | -0.1 | -0.2 |
| Total Agriculture | 0 | -10 | -0.2 | -0.4 | -0.1 | -0.2 |
| M&I Water Costs | -60 | -130 | -4.4 | -9.4 | -2.4 | -5.4 |
| **TOTAL 1/** | **-60** | **-130** | -4.6 | -9.8 | -2.5 | -5.6 |
| **California Total** | | | | | | |
| Agriculture | | | | | | |
| Reduced Output | -10 | -20 | -0.7 | -1.5 | -0.3 | -0.8 |
| Reduced Net Income | -50 | -100 | -2.3 | -5.0 | -1.2 | -2.7 |
| Total Agriculture | -60 | -120 | -3.0 | -6.5 | -1.6 | -3.5 |
| M&I Water Costs | -200 | -410 | -13.3 | -27.4 | -7.0 | -15.1 |
| **TOTAL 1/** | **-260** | **-530** | **-16.3** | **-33.9** | **-8.6** | **-18.6** |

Note: (1) May differ from sum of elements due to rounding.

TABLE 23

REGIONAL ECONOMIC IMPACT: AVERAGE YEAR FOLLOWING AVERAGE 5-YEAR BASE CONDITION
COMPARED TO THE PREFERRED ALTERNATIVE AVERAGE YEAR CONDITION

| | Employment (# of jobs) | | Output ($MM) | | PoW Income ($MM) | |
|---|---|---|---|---|---|---|
| **Region and Affected Sector** | **Direct** | **Total** | **Direct** | **Total** | **Direct** | **Total** |
| **Sacramento River** | | | | | | |
| Agric., Frst., Fish. | -10 | -10 | -0.4 | -0.5 | -0.2 | -0.3 |
| Mining | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Construction | 0 | 0 | 0.0 | -0.2 | 0.0 | -0.1 |
| Manufacturing | -10 | -20 | -1.6 | -2.2 | -0.6 | -0.8 |
| TCU | 0 | -10 | -0.2 | -0.9 | -0.1 | -0.5 |
| Trade | -40 | -70 | -1.1 | -2.1 | -0.7 | -1.3 |
| FIRE | -10 | -20 | -0.8 | -2.6 | -0.5 | -1.7 |
| Services | -20 | -60 | -0.9 | -2.8 | -0.6 | -1.7 |
| Government | 0 | -10 | -0.2 | -0.7 | -0.1 | -0.3 |
| Misc | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **TOTAL/1** | **-90** | **-190** | **-5.3** | **-12.0** | **-2.8** | **-6.6** |
| **San Joaquin River** | | | | | | |
| Agric., Frst., Fish. | 0 | -10 | -0.2 | -0.3 | -0.1 | -0.1 |
| Mining | 0 | 0 | -0.1 | -0.1 | 0.0 | 0.0 |
| Construction | 0 | 0 | 0.0 | -0.1 | 0.0 | -0.1 |
| Manufacturing | -10 | -10 | -0.8 | -1.1 | -0.2 | -0.3 |
| TCU | 0 | -10 | -0.3 | -0.6 | -0.2 | -0.3 |
| Trade | -10 | -30 | -0.4 | -1.1 | -0.2 | -0.6 |
| FIRE | -10 | -20 | -1.1 | -2.1 | -0.7 | -1.3 |
| Services | -30 | -50 | -1.2 | -2.2 | -0.7 | -1.3 |
| Government | 0 | 0 | -0.2 | -0.3 | -0.1 | -0.1 |
| Misc | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **TOTAL/1** | **-60** | **-120** | **-4.3** | **-7.9** | **-2.2** | **-4.2** |
| **Tulare Lake** | | | | | | |
| Agric., Frst., Fish. | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Mining | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Construction | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Manufacturing | -10 | -10 | -1.0 | -1.3 | -0.4 | -1.3 |
| TCU | 0 | 0 | 0.0 | -0.2 | 0.0 | -0.2 |
| Trade | -40 | -50 | -1.0 | -1.4 | -0.7 | -1.4 |
| FIRE | 0 | 0 | 0.0 | -0.4 | 0.0 | -0.4 |
| Services | 0 | -10 | 0.0 | -0.6 | 0.0 | -0.6 |
| Government | 0 | 0 | 0.0 | -0.1 | 0.0 | -0.1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Misc | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **TOTAL/1** | **-50** | **-80** | **-2.1** | **-4.1** | **-1.1** | **-4.1** |
| **Bay Area** | | | | | | |
| Agric., Frst., Fish. | 0 | 0 | 0.0 | -0.1 | 0.0 | 0.0 |
| Mining | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Construction | 0 | 0 | 0.0 | -0.1 | 0.0 | -0.1 |
| Manufacturing | -10 | -10 | -1.2 | -1.9 | -0.4 | -0.7 |
| TCU | 0 | -10 | -0.3 | -0.8 | -0.2 | -0.4 |
| Trade | -20 | -40 | -0.9 | -1.7 | -0.5 | -1.0 |
| FIRE | -10 | -20 | -1.0 | -2.3 | -0.6 | -1.5 |
| Services | -20 | -50 | -1.1 | -2.6 | -0.7 | -1.6 |
| Government | 0 | 0 | -0.2 | -0.3 | -0.1 | -0.1 |
| Misc | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **TOTAL/1** | **-60** | **-130** | **-4.6** | **-9.8** | **-2.5** | **-5.6** |
| **California Total** | | | | | | |
| Agric., Frst., Fish. | -10 | -20 | -0.6 | -0.9 | -0.3 | -0.5 |
| Mining | 0 | 0 | -0.1 | -0.1 | 0.0 | 0.0 |
| Construction | 0 | -10 | 0.0 | -0.5 | 0.0 | -0.3 |
| Manufacturing | -30 | -50 | -4.7 | -6.5 | -1.6 | -3.1 |
| TCU | -10 | -20 | -0.8 | -2.5 | -0.4 | -1.4 |
| Trade | -110 | -190 | -3.4 | -6.3 | -2.2 | -4.4 |
| FIRE | -20 | -60 | -2.9 | -7.4 | -1.8 | -4.9 |
| Services | -70 | -180 | -3.2 | -8.1 | -1.9 | -5.2 |
| Government | 0 | -10 | -0.6 | -1.4 | -0.3 | -0.7 |
| Misc | 0 | 0 | -0.1 | -0.1 | -0.1 | -0.1 |
| **TOTAL/1** | **-260** | **-530** | **-16.3** | **-33.9** | **-8.6** | **-20.5** |

Note:(1) May differ from sum of elements due to rounding.

Table 24

**REGIONAL ECONOMIC IMPACTS ON ALL SECTORS: AVERAGE YEAR FOLLOWING WET 5-YEAR BASE CONDITION COMPARED TO THE PREFERRED ALTERNATIVE AVERAGE YEAR CONDITION**

| | Impacts on all Sectors | | | | | |
|---|---|---|---|---|---|---|
| | Employment (# of jobs) | | Output ($MM) | | PoW Income ($MM) | |
| **Region Directly Impacted** | **Direct** | **Total** | **Direct** | **Total** | **Direct** | **Total** |
| **Sacramento River** | | | | | | |
| Agriculture | | | | | | |
| Reduced Output | 0 | -10 | -0.4 | -0.8 | -0.2 | -0.4 |
| Reduced Net Income | 30 | 50 | 1.0 | 2.6 | 0.5 | 1.4 |
| Total Agriculture | 20 | 40 | 0.6 | 1.8 | 0.4 | 1.0 |
| M&I Water Costs | -60 | -130 | -3.9 | -8.5 | -2.0 | -4.7 |
| **TOTAL 1/** | **-40** | **-90** | **-3.3** | **-6.7** | **-1.6** | **-3.6** |
| **San Joaquin River** | | | | | | |
| Agriculture | | | | | | |
| Reduced Output | 0 | 0 | -0.2 | -0.3 | -0.1 | -0.2 |
| Reduced Net Income | 100 | 170 | 3.7 | 8.1 | 2.1 | 4.5 |
| Total Agriculture | 90 | 160 | 3.6 | 7.8 | 2.0 | 4.4 |
| M&I Water Costs | -80 | -150 | -5.0 | -9.4 | -2.6 | -5.1 |
| **TOTAL 1/** | **20** | **10** | **-1.4** | **-1.6** | **-0.6** | **-0.7** |
| **Tulare Lake** | | | | | | |
| Agriculture | | | | | | |
| Reduced Output | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Reduced Net Income | -30 | -40 | -1.1 | -2.1 | -0.6 | -1.1 |
| Total Agriculture | -30 | -40 | -1.1 | -2.1 | -0.6 | -1.1 |
| M&I Water Costs | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **TOTAL 1/** | **-30** | **-40** | **-1.1** | **-2.1** | **-0.6** | **-1.1** |
| **Bay Area** | | | | | | |
| Agriculture | | | | | | |
| Reduced Output | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Reduced Net Income | 0 | 0 | -0.1 | -0.2 | 0.0 | -0.1 |
| Total Agriculture | 0 | 0 | -0.1 | -0.2 | 0.0 | -0.1 |
| M&I Water Costs | -60 | -130 | -4.4 | -9.4 | -2.4 | -5.4 |
| **TOTAL 1/** | **-60** | **-130** | **-4.5** | **-9.6** | **-2.5** | **-5.5** |
| **California Total** | | | | | | |
| Agriculture | | | | | | |
| Reduced Output | 0 | -10 | -0.5 | -1.1 | -0.2 | -0.6 |
| Reduced Net Income | 100 | 180 | 3.6 | 8.4 | 2.0 | 4.7 |
| Total Agriculture | 100 | 170 | 3.0 | 7.3 | 1.7 | 4.2 |
| M&I Water Costs | -200 | -410 | -13.3 | -27.4 | -7.0 | -15.1 |
| **TOTAL 1/** | **-100** | **-240** | **-10.3** | **-20.1** | **-5.3** | **-11.0** |

TABLE 25

REGIONAL ECONOMIC IMPACT: AVERAGE YEAR FOLLOWING WET 5-YEAR BASE CONDITION
COMPARED TO THE PREFERRED ALTERNATIVE AVERAGE YEAR CONDITION

| | Employment (# of jobs) | | Output ($MM) | | PoW Income ($MM) | |
|---|---|---|---|---|---|---|
| **Region and Affected Secto** | **Direct** | **Total** | **Direct** | **Total** | **Direct** | **Total** |
| **Sacramento River** | | | | | | |
| Agric., Frst., Fish. | 0 | -10 | -0.2 | -0.3 | -0.1 | -0.2 |
| Mining | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Construction | 0 | 0 | 0.0 | -0.1 | 0.0 | -0.1 |
| Manufacturing | 0 | -10 | -0.7 | -0.9 | -0.2 | -0.3 |
| TCU | 0 | 0 | -0.2 | -0.6 | -0.1 | -0.3 |
| Trade | 0 | -10 | -0.2 | -0.7 | 0.0 | -0.3 |
| FIRE | -10 | -20 | -0.8 | -1.8 | -0.5 | -1.1 |
| Services | -20 | -40 | -0.9 | -1.9 | -0.6 | -1.1 |
| Government | 0 | 0 | -0.2 | -0.5 | -0.1 | -0.2 |
| Misc | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **TOTAL/1** | **-40** | **-90** | **-3.3** | **-6.7** | **-1.6** | **-3.6** |
| **San Joaquin River** | | | | | | |
| Agric., Frst., Fish. | 0 | 0 | -0.1 | -0.2 | -0.1 | -0.1 |
| Mining | 0 | 0 | -0.1 | -0.1 | 0.0 | 0.0 |
| Construction | 0 | 0 | 0.0 | -0.1 | 0.0 | 0.0 |
| Manufacturing | 10 | 10 | 0.6 | 0.8 | 0.3 | 0.4 |
| TCU | 0 | 0 | -0.3 | -0.4 | -0.2 | -0.2 |
| Trade | 60 | 60 | 1.0 | 1.1 | 0.8 | 0.9 |
| FIRE | -10 | -10 | -1.1 | -1.2 | -0.7 | -0.8 |
| Services | -30 | -30 | -1.2 | -1.2 | -0.7 | -0.7 |
| Government | 0 | 0 | -0.2 | -0.2 | -0.1 | -0.1 |
| Misc | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **TOTAL/1** | **20** | **10** | **-1.4** | **-1.6** | **-0.6** | **-0.7** |
| **Tulare Lake** | | | | | | |
| Agric., Frst., Fish. | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Mining | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Construction | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Manufacturing | 0 | -10 | -0.5 | -0.7 | -0.2 | -0.7 |
| TCU | 0 | 0 | 0.0 | -0.1 | 0.0 | -0.1 |
| Trade | -20 | -30 | -0.5 | -0.7 | -0.4 | -0.7 |
| FIRE | 0 | 0 | 0.0 | -0.2 | 0.0 | -0.2 |
| Services | 0 | -10 | 0.0 | -0.3 | 0.0 | -0.3 |
| Government | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Misc | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **TOTAL/1** | **-30** | **-40** | **-1.1** | **-2.1** | **-0.6** | **-2.1** |
| **Bay Area** | | | | | | |
| Agric., Frst., Fish. | 0 | 0 | 0.0 | -0.1 | 0.0 | 0.0 |
| Mining | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Construction | 0 | 0 | 0.0 | -0.1 | 0.0 | -0.1 |
| Manufacturing | -10 | -10 | -1.2 | -1.9 | -0.4 | -0.7 |
| TCU | 0 | -10 | -0.3 | -0.8 | -0.2 | -0.4 |
| Trade | -20 | -40 | -0.8 | -1.6 | -0.5 | -1.0 |
| FIRE | -10 | -10 | -1.0 | -2.2 | -0.6 | -1.5 |
| Services | -20 | -50 | -1.1 | -2.6 | -0.7 | -1.6 |
| Government | 0 | 0 | -0.2 | -0.3 | -0.1 | -0.1 |
| Misc | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **TOTAL/1** | **-60** | **-130** | **-4.5** | **-9.6** | **-2.5** | **-5.5** |
| **California Total** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Agric., Frst., Fish. | -10 | -10 | -0.4 | -0.7 | -0.2 | -0.3 |
| Mining | 0 | 0 | -0.1 | -0.1 | 0.0 | 0.0 |
| Construction | 0 | 0 | 0.0 | -0.3 | 0.0 | -0.2 |
| Manufacturing | -10 | -10 | -1.7 | -2.7 | -0.5 | -1.2 |
| TCU | -10 | -10 | -0.8 | -1.8 | -0.4 | -1.0 |
| Trade | 20 | -20 | -0.5 | -1.9 | -0.1 | -1.2 |
| FIRE | -20 | -40 | -2.9 | -5.5 | -1.8 | -3.6 |
| Services | -70 | -130 | -3.2 | -5.9 | -1.9 | -3.8 |
| Government | 0 | -10 | -0.6 | -1.0 | -0.3 | -0.5 |
| Misc | 0 | 0 | -0.1 | -0.1 | -0.1 | -0.1 |
| **TOTAL/1** | **-100** | **-250** | **-10.3** | **-20.1** | **-5.3** | **-12.0** |

Note:(1) May differ from sum of elements due to rounding.

**TABLE 26**

**REGIONAL ECONOMIC IMPACTS ON ALL SECTORS: AVERAGE YEAR FOLLOWING DRY 5-YEAR BASE CONDITION COMPARED TO THE PREFERRED ALTERNATIVE AVERAGE YEAR CONDITION**

| | Impacts on all Sectors | | | | | |
|---|---|---|---|---|---|---|
| | Employment (# of jobs) | | Output ($MM) | | PoW Income ($MM) | |
| **Region Directly Impacted** | **Direct** | **Total** | **Direct** | **Total** | **Direct** | **Total** |
| **Sacramento River** | | | | | | |
| Agriculture | | | | | | |
| Reduced Output | -700 | -2240 | -92.1 | -194.5 | -30.8 | -86.9 |
| Reduced Net Income | 130 | 240 | 4.7 | 12.4 | 2.6 | 6.9 |
| Total Agriculture | -570 | -2000 | -87.4 | -182.1 | -28.2 | -80.0 |
| M&I Water Costs | -60 | -140 | 0.4 | -0.9 | -0.2 | -0.5 |
| **TOTAL 1/** | **-630** | **-2140** | **-91.8** | **-191.6** | **-30.5** | **-85.2** |
| **San Joaquin River** | | | | | | |
| Agriculture | | | | | | |
| Reduced Output | -10 | -20 | -0.7 | -1.5 | -0.3 | -0.7 |
| Reduced Net Income | -140 | -240 | -5.4 | -11.7 | -3.0 | -6.5 |
| Total Agriculture | -150 | -270 | -6.1 | -13.2 | -3.3 | -7.3 |
| M&I Water Costs | -80 | -150 | 0.0 | 0.0 | 0.0 | 0.0 |
| **TOTAL 1/** | **-230** | **-420** | **-11.0** | **-22.7** | **-5.9** | **-12.4** |
| **Tulare Lake** | | | | | | |
| Agriculture | | | | | | |
| Reduced Output | 0 | -10 | -0.2 | -0.5 | -0.1 | -0.2 |
| Reduced Net Income | -100 | -170 | -3.6 | -7.1 | -1.9 | -3.8 |
| Total Agriculture | -100 | -170 | -3.8 | -7.6 | -2.0 | -4.0 |
| M&I Water Costs | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **TOTAL 1/** | **-100** | **-170** | **-4.4** | **-8.8** | **-2.3** | **-4.6** |
| **Bay Area** | | | | | | |
| Agriculture | | | | | | |
| Reduced Output | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Reduced Net Income | -10 | -20 | -0.6 | -1.4 | -0.3 | -0.8 |
| Total Agriculture | -10 | -20 | -0.6 | -1.4 | -0.3 | -0.8 |
| M&I Water Costs | -60 | -130 | -0.5 | -1.1 | -0.3 | -0.6 |
| **TOTAL 1/** | **-70** | **-150** | **-5.0** | **-10.8** | **-2.8** | **-6.2** |
| **California Total** | | | | | | |
| Agriculture | | | | | | |
| Reduced Output | -710 | -2270 | -93.0 | -196.5 | -31.2 | -87.9 |
| Reduced Net Income | -120 | -190 | -4.8 | -7.8 | -2.6 | -4.1 |
| Total Agriculture | -830 | -2460 | -97.8 | -204.3 | -33.8 | -92.0 |
| M&I Water Costs | -200 | -420 | -0.1 | -1.9 | -0.5 | -1.1 |
| **TOTAL 1/** | **-1030** | **-2880** | **-112.2** | **-233.8** | **-41.4** | **-108.3** |

**TABLE 27**

**REGIONAL ECONOMIC IMPACT: AVERAGE YEAR FOLLOWING DRY 5-YEAR BASE CONDITION COMPARED TO THE PREFERRED ALTERNATIVE AVERAGE YEAR CONDITION**

| | Employment (# of jobs) | | Output ($MM) | | PoW Income ($MM) | |
|---|---|---|---|---|---|---|
| **Region and Affected Sector** | **Direct** | **Total** | **Direct** | **Total** | **Direct** | **Total** |
| **Region and Affected Sector** | **Direct** | **Total** | **Direct** | **Total** | **Direct** | **Total** |
| **Sacramento River** | | | | | | |
| Agric., Frst., Fish. | -450 | -630 | -26.1 | -33.0 | -13.4 | -16.6 |
| Mining | 0 | 0 | 0.0 | -0.1 | 0.0 | 0.0 |
| Construction | 0 | -30 | 0.0 | -2.1 | 0.0 | -1.2 |
| Manufacturing | -230 | -290 | -64.9 | -73.1 | -16.9 | -19.8 |
| TCU | 0 | -120 | -0.2 | -16.8 | -0.1 | -7.5 |
| Trade | 90 | -310 | 1.6 | -13.8 | 1.2 | -8.1 |
| FIRE | -10 | -200 | -0.9 | -22.7 | -0.5 | -14.6 |
| Services | -20 | -500 | -1.0 | -22.8 | -0.6 | -13.8 |
| Government | 0 | -50 | -0.2 | -7.2 | -0.1 | -3.5 |
| Misc | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **TOTAL/1** | **-630** | **-2130** | **-91.8** | **-191.6** | **-30.5** | **-85.2** |
| **San Joaquin River** | | | | | | |
| Agric., Frst., Fish. | -10 | -20 | -0.8 | -1.2 | -0.4 | -0.5 |
| Mining | 0 | 0 | -0.1 | -0.1 | 0.0 | 0.0 |
| Construction | 0 | 0 | 0.0 | -0.3 | 0.0 | -0.1 |
| Manufacturing | -30 | -40 | -3.8 | -5.1 | -1.4 | -1.9 |
| TCU | 0 | -10 | -0.3 | -1.2 | -0.2 | -0.6 |
| Trade | -140 | -210 | -3.6 | -5.8 | -2.4 | -3.7 |
| FIRE | -10 | -30 | -1.1 | -4.2 | -0.7 | -2.7 |
| Services | -30 | -100 | -1.2 | -4.3 | -0.7 | -2.6 |
| Government | 0 | -10 | -0.2 | -0.5 | -0.1 | -0.2 |
| Misc | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **TOTAL/1** | **-230** | **-420** | **-11.0** | **-22.7** | **-5.9** | **-12.4** |
| **Tulare Lake** | | | | | | |
| Agric., Frst., Fish. | 0 | -10 | -0.3 | -0.4 | -0.1 | -0.4 |
| Mining | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Construction | 0 | 0 | 0.0 | -0.1 | 0.0 | -0.1 |
| Manufacturing | -20 | -20 | -2.1 | -2.7 | -0.7 | -2.7 |
| TCU | 0 | 0 | 0.0 | -0.4 | 0.0 | -0.4 |
| Trade | -80 | -110 | -2.1 | -2.9 | -1.5 | -2.9 |
| FIRE | 0 | -10 | 0.0 | -0.9 | 0.0 | -0.9 |
| Services | 0 | -30 | 0.0 | -1.2 | 0.0 | -1.2 |
| Government | 0 | 0 | 0.0 | -0.2 | 0.0 | -0.2 |
| Misc | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **TOTAL/1** | **-100** | **-170** | **-4.4** | **-8.8** | **-2.3** | **-8.8** |
| **Bay Area** | | | | | | |
| Agric., Frst., Fish. | 0 | 0 | 0.0 | -0.1 | 0.0 | 0.0 |
| Mining | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Construction | 0 | 0 | 0.0 | -0.1 | 0.0 | -0.1 |
| Manufacturing | -10 | -10 | -1.4 | -2.2 | -0.5 | -0.8 |
| TCU | 0 | -10 | -0.3 | -0.8 | -0.2 | -0.4 |
| Trade | -30 | -50 | -1.1 | -2.0 | -0.7 | -1.3 |
| FIRE | -10 | -20 | -1.0 | -2.4 | -0.6 | -1.6 |
| Services | -20 | -60 | -1.1 | -2.8 | -0.7 | -1.8 |
| Government | 0 | 0 | -0.2 | -0.3 | -0.1 | -0.2 |
| Misc | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| TOTAL/1 | -70 | -150 | -5.0 | -10.8 | -2.8 | -6.2 |
| **California Total** | | | | | | |
| Agric., Frst., Fish. | -470 | -660 | -27.2 | -34.6 | -13.9 | -17.5 |
| Mining | 0 | 0 | -0.1 | -0.2 | 0.0 | -0.1 |
| Construction | 0 | -40 | 0.0 | -2.6 | 0.0 | -1.5 |
| Manufacturing | -290 | -370 | -72.2 | -83.1 | -19.6 | -25.2 |
| TCU | -10 | -140 | -0.8 | -19.3 | -0.4 | -8.9 |
| Trade | -170 | -680 | -5.0 | -24.5 | -3.3 | -16.0 |
| FIRE | -20 | -260 | -2.9 | -30.2 | -1.8 | -19.8 |
| Services | -70 | -680 | -3.3 | -31.1 | -2.0 | -19.3 |
| Government | 0 | -60 | -0.6 | -8.2 | -0.3 | -4.1 |
| Misc | 0 | 0 | -0.1 | -0.1 | -0.1 | -0.1 |
| TOTAL/1 | -1030 | -2880 | -112.2 | -233.8 | -41.4 | -112.5 |

Note:(1) May differ from sum of elements due to rounding.

# SECTION 3

# MUNICIPAL AND INDUSTRIAL WATER USE ECONOMICS

# MUNICIPAL AND INDUSTRIAL ECONOMICS

The municipal and industrial economics analysis is based upon the Average-Average tiered pricing scenario. This analysis is based upon the impacts to CVP contractors. This is different than the municipal and industrial economic analysis that was included in the PEIS.

The PEIS municipal and industrial water cost analysis primarily evaluated the impacts on the need and cost to transfer water to non-CVP municipalities. Therefore, the analysis included water costs for many non-CVP water users. For example, the municipality in the San Joaquin River Basin was based upon the Cities of Stockton and Fresno water costs which are not based on CVP water, as described in the Municipal Water Costs Methodology and Modeling Technical Appendix to the PEIS.

The analysis included in the following table is based only on CVP contractors in order to define the cost of CVP water under the Tiered Water Pricing proposal.

## TABLE 28

### SUMMARY OF M&I ECONOMICS ANALYSIS FOR AVERAGE YEAR CONDITIONS FOR REGIONAL ECONOMICS

| Result | Preferred Alternative Average | Change from the Preferred Alternative Average | | |
|---|---|---|---|---|
| | | Average-Average | Dry-Average | Wet-Average |
| **Average Condition** | | | | |
| **Supplies, 1,000 acre-feet (1)** | | | | |
| Sacramento Valley | 929.0 | 0.0 | 0.0 | 0.0 |
| Bay Area | 1024.0 | 0.0 | 0.0 | 0.0 |
| San Joaquin Valley | 704.0 | 0.0 | 0.0 | 0.0 |
| Central and South Coast | 5921.0 | 0.0 | 0.0 | 0.0 |
| **Average Condition** | | | | |
| **Economic Costs, Million $ (2)** | | | | |
| Sacramento Valley | 1.1 | 4.1 | 4.3 | 4.1 |
| Bay Area | 3.5 | 4.6 | 4.6 | 4.6 |
| San Joaquin Valley | 0.3 | 5.2 | 5.2 | 5.2 |
| Central and South Coast | 649.0 | 0.0 | 0.0 | 0.0 |

NOTES:
Water transfers not considered as replacement supplies in this comparison.
(1) After purchase or development of non-transfer replacement supplies to make supply equal demand.
(2) Total costs include replacement supplies, restoration payments and metering. A negative cost means a net gain is estimated.

# APPENDIX D

# LIST OF PREPARERS

**APPENDIX D**

# LIST OF PREPARERS

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